NATURE

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Vol. 141 SATURDAY, MARCH 26, 1938 No. 3569

Ethics and Ethnology

ALTHOUGH nearly fifty years lie between T. H. Huxley's Romanes Lecture on "Evolution and Ethics", delivered at Oxford in 1892, and the recent address on "Science and Ethics" by Dr. E. G. Conklin as outgoing president of the American Association for the Advancement of Science (see NATURE, January 15, p. 101), there is in them a striking congruity of outlook. In both, the ethical idea is paramount in the application of evolutionary doctrine to the problems of man's advancement. While for Huxley the blind struggle for existence, which had brought sub-human forms to the threshold of intelligence, henceforward in human society is dominated by moral and intellectual forces in a conflict—in the ultimate resort, one of ethical ideals—for Dr. Conklin determinism, to many an inescapable corollary of the modern approach to evolutionary problems, is mitigated by the selective powers of the human will, which can mould the forces governing human development to such ends as the ethical standard—the ideals of justice, truth, beauty, sympathy—may formulate. Nor does it affect materially the argument of either that the end to which the selective process is directed may vary with time, place and circumstance. Its virtue lies in the control which it exercises over material forces to make man potentially master of his fate.

That the ethical ideal, like the organic world, is subject to a process of development, and that it is variable according to chronological period, geographical distribution, and social environment is a matter of common observation. Morality, it has been remarked, is a question of latitude; and as Huxley pointed out, systems of ethics evolve. Nowadays modern ethnological inquiry would stress rather their relative character, the function of a specific ethical system in relation to a particular society and ritual of religious belief. Take, for example, some of the Bantu peoples of South or Central Africa, more especially those of Amazulu stock, which before effective control by British rule were organized mainly, if not entirely, for war. The whole ethical code with its 'religious' sanctions—penalties inflicted by spirits for the breaking of taboos—was directed to the avoidance or performance of actions affecting the success of the community in war. Among tribes, however, whose social organization was based on pasturage or agriculture rather than on war, the moral code was directed to the preservation of the community through the promotion of fertility. The diverse aims and preoccupations of the two types of community produced moral codes of an entirely different character, but each in complete harmony with its particular social environment. The detribalized natives of Africa illustrate the dangers of interference by well-intentioned, but ill-considered, effort with moral codes and attendant beliefs without effective substitutes which will ensure continued stability in that society.

The ethical system which derives its compelling force from reference to the claims and needs of a given form of society, affords no guidance for conduct as between man and man outside the group. In many primitive societies, members of the group alone are held worthy of the collective title of 'men'; and the implication of this group particularity absolves its members in contact with outsiders from the moral obligations and restraints observed in the relations of members of the group one with another. This is well illustrated in the history of the peoples pictured in the Old

Testament, in which the moral code imposed by the Decalogue is a matter for strict observance only as between the people of Israel. They are a 'chosen' people; and neither the sanctity of personal possessions nor the injunction "Thou shalt not kill" affect the warlike and aggressive followers of Jehovah when they fall upon and despoil a neighbouring tribe.

The teaching of Christ and the missions to the Gentiles inculcated a broader conception of the ethical relations which should subsist among the various branches of mankind; while the concept of catholicity was still further reinforced in the early Church through the influence of the Stoic doctrine of the brotherhood of man and the citizenship and *Pax Romana* of the Empire. The humanistic ideal, however, could not withstand such disintegrating forces as the Great Schism between the Eastern and Western Church, the growth of nationality and that reaction against freedom of thought which found expression in the Papal Bulls against heretics and the persecutions of schismatics, witches and such heathen as the Indians of America. The touchstone of the relations between individuals ceased to be in conformity with a standard resting on the broad basis of humanistic ethics and a sanction derived from religious belief, and became a question of adherence to an ecclesiastical organization, which claimed to be universal and of supreme authority in conduct and doctrine.

It is unnecessary to recall in any detail the disastrous consequences of this imposition of conformity to ecclesiastical authority in its effect in checking freedom of thought and intellectual progress for centuries—they are too familiar to need recapitulation; but recent pronouncements of members of the Church of England on questions amenable to the evidence of scientific investigation, for which at one period of the world's history they would have been burned at the stake, are some measure of the irreparable loss which science and humanity would have suffered had freedom of thought and the teaching of observation and experiment not resisted successfully the dictates of authority.

After fifteen years' deliberation, the Archbishops' Commission on Christian Doctrine has issued a report, which has been received with widespread astonishment, some bewilderment, and in certain quarters with something like dismay. The Commission disclaims judicial functions, nor is it unanimous: its findings are a statement of views on certain doctrinal matters, which have been the subject of controversy, held by various bodies of opinion within the Church of England and represented on the Commission.

The more outstanding of the Commission's pronouncements deal with such matters as the inerrancy of the text of the Bible, which it is stated in view of increased knowledge can no longer be maintained; the Creation, which it is acknowledged is regarded by many Christian thinkers as a continuous process; evil spirits, which may be taken symbolically, though, it is important to note, it is added that when Christ spoke of Satan, he may have shared the current belief of his time; miracles, a matter upon which some members believe it to be "more congruous with the wisdom and majesty of God that he should never vary the regularities of Nature"; the Virgin Birth, and the Resurrection in its physical features, which are interpreted symbolically.

This report will be a landmark in the history of Christian doctrine, even though it may be that the Rev. Dr. Inge, who seems to stand among those not least bewildered, is correct when he says that it "marks the position of King Canute's chair in this year of grace". It is unnecessary to stress the fact that it includes within the orthodox fold, or at least as maintaining a position not incompatible with Christian doctrine, those who now accept the more salient of the 'heresies' of scientific thinkers, which convulsed English society in the nineteenth century from the days of Dean Buckland down to the pitched battles which took place on the scientific positions of Darwin, Huxley, Tyndall and their successors.

Some critics would stigmatize the report as a capitulation to the forces of modernism and scientific materialism. This argues a failure to appreciate the findings of ethnological science and the history of religious belief. From such studies, the salient fact emerges that religious beliefs, when viewed objectively, are seen, like other component elements in human society, and most conspicuously, perhaps, the ethical standard, to be conditioned by time and place—the products of a specific tradition and culture, and in the course of time to undergo a process of development, or evolution in the more popular sense of the term. To illustrate this, it is unnecessary to go outside the Christian religion itself. The prominence given to the Virgin Mary in the Roman Church was undoubtedly fostered and reinforced by folk-memory of the cult of the mother goddess in Mediterranean

belief; and hence the Reformation may, in part, be regarded as a revolt from an alien, southern form of ritual by peoples of northern Europe, to whom the belief in a God of Battles was more congenial. One of the effects of this diversion of emphasis in cult is to be seen in the predominating influence of the Old Testament in the life of the peoples of England and Scotland in the seventeenth century. This influence continued to be marked until superseded by the humanitarian ideals and missionary spirit of the New Testament, with the aid of philosophic doctrine, in the late eighteenth and nineteenth centuries.

The attitude, then, of the members of the Commission on matters of disputed doctrine must be construed as more than one of toleration only. It implies recognition of the fact that, just as in scientific investigation, hypothesis—for example, as to the nature of the universe, or as to the antiquity and descent of man—is subject to modification in the light of increased knowledge, so in matters of theological doctrine, orthodoxy is not static, but must vary in connotation with increase of understanding and a clearer view of the cosmic process. Further, that such understanding may bring about change in forms of belief, without affecting faith in the central doctrine of Christianity. The findings of the Commission would have been impossible a hundred years ago.

It may seem that to hold such a view of the relation of the evolution of theological dogma to the development of scientific thought is to make the validity of religious belief dependent upon the finite intelligence of man and to be incompatible with the tenets of a religion which takes its stand upon divine revelation. Yet is it not possible to regard both the growth of scientific knowledge and the development of dogma, each in its respective field, as two sides, two aspects of the same process—the search for truth, in which the Divine Purpose is revealed gradually to man *pari passu* with the preparation of his heart and intellect to receive it with understanding.

Whether the preparation of man's heart to accept the advances of science and the enlargement of theological doctrine, in other words the ethical ideal, has kept pace with development is more open to question. The prostitution of scientific discovery to the forces of destruction, and the economic dislocation, of which the consequences have more than neutralized the advantages of the application of scientific results and methods to production, would argue strongly to the contrary—and these are two only of numberless disharmonies. For this lag of the ethical ideal, the divorce of faith and reason, one of the most outstanding features of intellectual development in the nineteenth century, must be held largely responsible. It was, in fact, the diverging tendencies of scientific thought and theological doctrine in the hundred years before the Great War which for a large part of that period went near to sterilizing the more progressive thinkers in contributing to social advancement.

Dr. Conklin, in opening his address, stressed the advantage that might accrue from more effective co-operation between science and religion in the field of practical ethics. Many will feel that serious obstacles standing in the way of such co-operation have now been removed by the acceptance or toleration of certain of the principles fundamental in the scientific approach to problems of human betterment. The materialistic position into which scientific thought was virtually forced by nineteenth century orthodox rejection of evolutionary theory was saved from ultimate sterility and negation by a fervid belief in the perfectability of man. Notwithstanding a wave of pessimism now current, such optimism remains the philosophic postulate of much of the activities of research, justifying scientific wisdom of her children.

In the course of social evolution, the lesson of evolutionary ethics is that the ethical bond is accepted by an ever-widening circle from intimate family group to nation. In a modern world in which separatist ideas are paramount, this tendency to larger aggregation has suffered a check; and among modern social and intellectual forces, science alone speaks clearly in a tongue which meets with universal understanding. This has been shown in the recent fraternization of Indian, British and foreign men of science during the Indian Science Congress, though that meeting took place among peoples heated in political controversy. Yet religious toleration, at least among the more advanced, has now reached a point at which the English Church can not only unite with British Nonconformity in the attack on social problems, but also can seek a measure of union with the Eastern Church and other communions. The time has surely come for co-operation between religion and science in an endeavour to unite all men of good will, irrespective of creed, race and nationality, in seeking to arrive at a solution of the problems, fundamentally ethical, which now confront mankind.

Regiomontanus and his Calendar

Der deutsche Kalender des Johannes Regiomontan, Nürnberg, um 1474
Faksimiledruck nach dem Exemplar der Preussischen Staatsbibliothek. Mit einer Einleitung von Ernst Zinner. (Veröffentlichungen der Gesellschaft für Typenkunde des XV Jahrhunderts—Wiegendruckgesellschaft, Reihe B: Seltene Frühdrucke in Nachbildungen, Band 1.) Pp. 80. (Leipzig: Otto Harrassowitz, 1937.) 20 gold marks.

FOR thirty years, the Gesellschaft für Typenkunde des XV Jahrhunderts has issued facsimile examples of print characteristic of that period: not for the sake of the text, but in aid of typographical study. These are being continued as Series A; but the Society has now taken over the publishing function of the younger Wiegendruckgesellschaft, and under the heading Reihe B it has begun, with the present small volume, a series of facsimiles (with suitable introductions) of complete printed works belonging to the fifteenth century. By means of this new series, the Society hopes to spread sympathy for its field of study not only among typographic scholars but also among persons learned in other fields, whose interest will be gained through reading characteristically fifteenth century works that are too rare in the originals for any but bibliographers and collectors to meet. This is an admirable plan; and to judge from this first example, it ought to succeed in its object; for the work now chosen is capable of interesting students of almost any aspect of the Renaissance.

Johann Müller, born in 1436 in the Franconian village of Königsberg, was variously called Johan von küngsperg, Hans von Königsberg, Joannes Königisberger, Joannes de Monte Regio, de Regiomonte, or, with the elevated simplicity which beseemed his fame, as Regiomontanus. He was one of those men of versatile genius—our own Robert Hooke, two centuries later, was of kindred stuff—who combine all sorts of practical ingenuity with accurate observation and with a strong capacity for abstract calculation in the service of concrete problems. A founder of the modern study of cometary movements and a fine general astronomer, the chief pre-Gregorian clarifier of the complex medieval calendar, and a founder of trigonometry (to mention no other activities), his masterliness was long acknowledged; and, but for his death at forty years of age, he might have put his name among the really great. A new account of his life is being produced by Prof. Ernst Zinner, director of the Observatory at Bamberg, and should afford a thorough and authoritative judgment.

Among Müller's subordinate feats was the setting up of his own press at Nuremberg, about 1472, mainly for the sake of printing his own and allied works correctly. Because of the need for methods of printing ruled tables of data, geometrical diagrams, accurately divided scales, and instruments of calculation, this was a courageous and innovating enterprise, especially at so early a point in the growth of the art. Müller's ingenuity was equal to the task; moreover, a young Augsburg man then in his employ, Erhard Ratdolt, soon carried his Nuremberg training to Venice, and later back to Augsburg, with such effect as to become the foremost astronomical and mathematical printer of the century; and he inaugurated this career by re-printing at Venice his former master's calendar, just as Müller himself had chosen as the first work for his press an astronomical treatise of his own former teacher at Vienna, Peuerbach. Müller's press lapsed in 1475 when he was summoned from Nuremberg to Rome by Sixtus IV to reform the calendar, and died there; but his quick technical success as a printer, no less than his merit as a chronologer and astronomical reckoner, can be gauged from the slim quarto under review.

Prof. Zinner gives a biographical notice and a clear and helpful commentary on the use and the vocabulary of the facsimile of Müller's (1474) printing of his German calendar, which is prefaced also by a short bibliographical note. Most fifteenth-century calendars were, like ours, for the current year only: they were single broadsides for putting on the wall, and sometimes bore New Year greetings in their initial letter. That of Regiomontanus, however, was a much more thorough-going and more valuable affair. How valuable may be judged from the facts that between 1474 and the end of the century it went through more than fourteen editions—Latin, German and Italian—and that it is recorded to have been used by Columbus and by Vasco da Gama on their voyages. Its first part is a semi-perpetual tabular calendar of twelve leaves, covering especially the two-cycle period from 1475 to 1513. Besides giving full data for the days of the week and month, Church feasts fixed and movable, the courses of sun and moon and the hour and minute of new and full moon at Nuremberg for any year of the period, it gives a conversion table for some sixty other localities,

with their latitudes. (The only English place is Ochsenfurt, of lat. 53°—it is now 51° 46′—while Hibernia and Schotland are both compressed to lat. 59°—about that of the Orkneys. But European cities are better defined.)

There follow orderly predictions of each of the sixty eclipses of sun and moon from 1475 to 1530, giving for each its date, times to the nearest minute, half-duration, and maximum obscuration to the nearest 1/12 diameter, this latter being also depicted by a large and exact woodcut in each case. The explanatory text follows, in a kindly Bavarian dialect—"nach meinem slechten tewtsche und chlainem vermögen"—and goes on, with tables, to define the paths of sun and moon up to 1532, including a short divagation on the best times for letting blood, which is the only relic of astrology admitted by this scientific observer.

Finally, there are instructions on the making and use of sundials and other chronological instruments, the woodcut patterns of which form the last four of the thirty leaves. One of these has three concentric disks with circularly graduated scales, two of which can be rotated, for the purpose of reading off corresponding values, on a central thread dangling from the leaf. The fourth cut lacks in facsimile what still survives in some originals as a most unusual component of any book, a doubly pivoted brass arm with a radial cord; but such an omission can scarcely be grudged, and is made good by Prof. Zinner's account of it in the preface.

The whole facsimile seems to be scrupulously exact (except, naturally, that it does not attempt to imitate the paper or the quiring of its original). Mention must also be made of the very agreeable roman fount in which the modern introduction is set. One's only qualm is caused by the price, which is likely to prevent the edition from doing what it was meant to do; and one may venture the hope that the Gesellschaft für Typenkunde will make the margin between cost and purchase-price as small as possible, so as to ensure the wide sale which this promising series deserves.

IRVINE MASSON.

Clinical Studies of the Heart

Diseases of the Heart: described for Practitioners and Students. By Sir Thomas Lewis. (Department of Clinical Research, University College Hospital, London.) Second edition. Pp. xx + 297. (London: Macmillan and Co., Ltd., 1937.) 12*s*. 6*d*. net.

THE first edition of this book was published in 1933; it was reprinted in 1933 and in 1934, and translations have also been made into German, Dutch, Italian, Spanish and Portuguese, sufficient proof of the help which medical men all over the world have found in its teaching. A second edition has now appeared, though with few changes requiring note. The printing is on a slightly better paper which gives a most comfortable page for the reader's eye, but the illustrations are all unaltered and the only part that has been freely re-written is the chapter on pericarditis.

Research in heart disease has not slackened during the five years since the first edition came out, but Sir Thomas Lewis has not spoiled his book by yielding to the ordinary temptation to add to it every new theory or observation, irrespective of whether it has been fully tested and proved to be of value to the medical man. Even for that much debated and common malady, high blood pressure, he is content to describe its features and treatment, while for its cause he states with simple brevity, refusing all discussion of theories, that it has not yet been discovered.

The bane of most of the modern text-books of medicine is their incomprehensible comprehensiveness. Every rare event or complication is mentioned, to lie there for reference; every remedy that has been tried is listed; and all the modern as well as many of the older theories of causation are cited, often with only the labelling name of the sponsor of each as though that were enough for the sorting of such baggage without any description of contents. The accumulated mass hides the thought of the writer and chokes the reader's mind.

Lewis has deliberately avoided these faults. "An ideal that I have striven hard to attain is simplicity in teaching"—that is the wish emphasized in the preface to his book, and he has achieved it by restricting himself to a clear, though of necessity dogmatic, statement of his personal ways of thought and practice. But his views are those of a master of the subject, both in its experimental and clinical aspects, who for thirty years has continued to publish a succession of monographs and papers describing the rigid scientific analysis of problems dealing with the

heart and circulation, and who through all that time has sought to translate such refinements of knowledge into practical modes that will guide thought and observation at the bedside to an equal scientific accuracy.

It may be recalled how Lewis's "Mechanism of the Heart Beat", an elaborate treatise on electrocardiography, was followed a year later in 1912 by a booklet of 100 pages on "Clinical Disorders of the Heart Beat", which gave to medical men the simple rules that all have since adopted for analysis at the bedside, without electrocardiograms, of the ordinary irregularities of the pulse. His present text-book on the whole subject of diseases of the heart summarizes the new attitude to those clinical problems that he himself has progressively taken and described in a series of papers with such clear argument that it has already been accepted by many leading teachers throughout the medical world. He writes with the aim of showing medical practitioners how to deal with living patients, of making them alert to judge each symptom that can tell of derangement of function in the living man; and so he refers but little to the older classifications of disease that were based on the isolated anatomical lesions to be revealed after death. Morbid physiology rather than morbid anatomy is the derangement that the clinician is invited to study and seek to correct. With all possible simplicity, this central idea is developed in its logical sequence through each chapter of the book.

For the reader who can forget much that he has been taught in the past, and look on his own clinical experiences in this fresh light, the book is an inspiring guide. Sir Thomas Lewis has thought as a physiologist, but his clinical work has always driven him to find out the meaning of physiology for practical medicine; and his matured teaching in this book has the conciseness gained by twenty years of testing and shaping it against the minds of his undergraduate students at University College Hospital. It is a model of what clinical science can achieve to help the practising profession.

Polymerization

Polymerization:
and its Applications in the Fields of Rubber, Synthetic Resins, and Petroleum. By Prof. Robert E. Burk, Howard E. Thompson, Archie J. Weith, and Ira Williams. (American Chemical Society Monograph Series, No. 75.) Pp. 312. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1937.) 37*s*. 6*d*. net.

THE chemist at one time was mainly engaged in analytical activities; since 1900 he has set to work to make in the laboratory the less complicated natural crystalline substances of which he had discovered the constitution. Now that this task is largely completed, the urge is to polymerize, which means to build up very large molecules of amorphous colloid character, starting, however, from relatively simple substances. Promising fields of practical application of such effort have been found in rubber, synthetic resins and petroleum. This book deals with these; their magnitude and complexity are witnessed by the fact that four authors are required, whose names are attached to their respective chapters.

An immense amount of work has evidently been done in mastering the literature of the subject and sorting it into an accessible form, and perhaps chief praise will be given to the chapter headed "Catalysis and Polymerisation" by R. E. Burk, in which a table some sixty pages long is given, listing in alphabetical order the polymerization catalysts, the conditions under which they are used, the compounds polymerized and the results obtained.

Reference to this list is facilitated by a special index of the compounds. The research worker who uses it is able either to choose the best catalyst for a specific purpose or to ascertain the various methods of polymerizing a particular substance: references are given to the original papers. The chapter might appropriately be headed "Polymerization made easy" in view of the immense amount of time it is going to save for future workers.

Prof. Burk is responsible for the chapters on the mechanism of polymerization and the structure of polymers.

The second half of the book deals with the specific industries, rubber by I. Williams, resins by A. J. Weith and petroleum by R. E. Burk. The first two are engaged in the respective industries, and may be judged competent to give reliable and practical reports.

There is a useful theoretical chapter by H. E. Thompson on the relation between molecular structure and polymerization.

The book will undoubtedly command a wide and appreciative public among present and future 'polymerizers'. E. F. A.

Entwicklungsbiologie und Ganzheit:
ein Beitrag zur Neugestaltung des Weltbildes. Von Prof. Dr. B. Dürken. Pp. vi+207. (Leipzig und Berlin: B. G. Teubner, 1936.) 6.80 gold marks.

THIS book is addressed not so much to the professional biologist as to the intelligent public and the philosopher. Its aim is to discuss anew what sort of mental picture we shall form of living organisms, and thus what kind of problems we shall formulate about them and what kind of answers we shall consider satisfactory. The question is discussed primarily with reference to the data of experimental embryology, which have so often led to similar disquisitions in the past. The fundamentals of our knowledge in this field, including the more important recent advances, are very clearly summarized in the middle section of the book, and this forms a valuable introduction to the subject, illustrated with admirable diagrams.

The philosophical point of view of the author is that of *Ganzheitsbiologie*, which corresponds more or less to what is known as organicism in Great Britain. This involves a rejection of both vitalism and mechanism, which, it is claimed, are characteristic products of the last century, with its over-emphasis on elementary particles. Biology, and the whole outlook of the present day, require a totally different method of approach, which is formulated thus: "The whole is not determined by the specific characters of its parts, but conversely the specific character of the parts depends on the primary whole".

There is probably, in spite of Viennese philosophers, a certain meaning and even truth in this statement. But what is required at the present juncture is an exact definition of what is meant by the 'primary whole'. Until this is provided, the statement is so vague that almost any conclusion can be drawn from it at will. In this book there creeps in at the end the deduction, which most scientific workers will have learnt to regard with some suspicion, that "Gemeinnutz geht vor Eigennutz". But in general the book is free from obvious politics.

An Introduction to Projective Geometry
By C. W. O'Hara and D. R. Ward. Pp. ix+298. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 12*s.* 6*d.* net.

THIS text-book should evoke in the student a realization of the infinite possibilities opened up by the many geometries included in the general scheme in which the classical geometry of his curriculum occupies a very subsidiary place. Starting with the initial propositions of incidence of lines and points, the synthetic method is developed up to the interpretation of the more complex properties of the conic. Then, co-ordinate systems are introduced projectively, to lead to the definition in projective terms of distance and angle. The various metrical geometries, both Euclidean and non-Euclidean, are discussed, and Euclidean geometry is shown to be a special case of the general projective metrical geometry.

The authors maintain that in two-dimensional projective geometry most of the fundamental ideas pervading the whole subject are developed, and that an introduction to these ideas in the simplified fields of points and lines is better than in the more complicated fields of the higher dimensions. In the last chapters, possible developments are indicated and the application of the subject to physical geometry is shown. Furthermore, the part played by the special theory of relativity in the theory of physical geometry is shown to be an application of the principles which have been developed in the book.

The book is intended for scholarship candidates and first-year university students. A. v. Z.

Einführung in die chemische Physiologie
Von Prof. Dr. E. Lehnartz. Pp. viii+420. (Berlin: Julius Springer, 1937.) 19.60 gold marks.

AN enormous amount of information has been packed into this attractively produced volume. The first hundred pages give the chemical structure of all the more important substances found in living tissues. Forty pages are devoted to physical chemistry. Vitamins, hormones and enzymes are then discussed in separate sections, and the last 130 pages are devoted to metabolism. Generally speaking, the book is very complete and up-to-date (1937) and is clearly based on a wide knowledge of the German literature, but the work of Rowntree on the thymus, for example, is omitted, presumably because the results were published in America. The author is to be congratulated on the tables he gives showing the distribution of vitamins in different foods. A few years ago such tables were vague and qualitative, but so much progress has been made recently, that it is now possible to give the actual concentrations of vitamins A, B_1, B_2, C and D in terms of the weight of vitamin in 100 gm. of material.

The main users of this book, in Great Britain at any rate, will probably not be biochemists, but those others whose research work sometimes brings them in contact with biochemical problems. Information is easy to find and references are given, not to original papers, but to more complete monographs.

Schwingende Kristalle:
und ihre Anwendung in der Hochfrequenz- und Ultraschalltechnik. Von Prof. Dr. Ludwig Bergmann. (Mathematisch-Physikalische Bibliothek, Reihe 1, Band 93.) Pp. 47. (Leipzig und Berlin: B. G. Teubner, 1937.) 1.20 gold marks.

THIS is a remarkable *tour de force*. In five brief but lucid chapters on piezo-electric phenomena, piezo-electric crystals in high-frequency fields, the application of oscillating crystals in high-frequency technique and electro-acoustics, the applications in ultra-sonic technique and the significance of ultrasound in science and technics, the author presents a simple and amazingly complete picture of the applications of oscillating crystals. The book has a wealth of illustrations (more than one per page of text), of which neither half-tones nor line diagrams suffer any loss in value from the smallness of size which is imposed by the attractively compact form of this popular monograph.

Crop Production without Soil

By Prof. W. F. Gericke, University of California

THE tenets of water culture are known to plant physiologists from an extensive literature. The first papers appeared more than three-quarters of a century ago. Although water cultures are used widely in experimental studies of plant physiology and soil science, the literature is singularly devoid of any suggestion of the economic possibilities of the method—crop production without soil. A brief paper in 1929 was the first announcement that crop production by water culture is practicable[1]. Beginning in 1935, a number of growers, convinced that the method had possibilities, established the first production plants; these are under the author's supervision and, although organized as commercial ventures, are administered as the author's experiments. The largest plant covers two acres.

While a history of the development of the economic use of water culture would not be complete without mention of the laboratory experiments, nevertheless the idea was not born wholly out of the laboratory concepts. Crop production by water culture is not a large-scale use of previously employed technique. Much of the idea was developed from extra-laboratory observations and considerations, from studies and analyses of the physiological and ecological conditions of practical farming operations; and these gave the cue to the devising of suitable techniques, and providing favourable ecological conditions. The technique of the laboratory as heretofore used and that of practical operation differ not only as to physical features but also primarily in physiological concepts and interpretations.

With the establishment of the economic use of water culture, it appeared well to have a word that would distinguish between the two uses. It was found that 'aquiculture' had already been appropriated. 'Hydroponics'[2] was then suggested by Dr. W. A. Setchell, University of California, to designate the "art and science of crop production in liquid culture media". The term 'water culture' can thus be reserved to its historic use and meaning—the growing of plants in nutrient solutions for experimental studies in plant physiological laboratories.

In order to prove the economic feasibility of water culture, evidence was needed that yields sufficiently large were possible to warrant the investment for the equipment required. Consequently, experiments were designed to obtain data on productive potentiality of unit areas of nutrient water surface so that comparison could be made with known production by agriculture.

The 'limiting factor' in yields by agriculture in climates suitable thereto are usually pedological. If these inhibitions could be overcome by water culture, then it should be possible to increase yield per unit area of surface by closer spacing of the plants. Increase in yield would then simply be a function of increase in stand, granted, of course, that the individual plants grown by water culture are as good as those grown by soil. Experiments showed it was possible to use closer spacing for some crops in hydroponic production than in field production; this gave, therefore, expectation of corresponding increase in yield.

Crop production comes as the result of many processes, some of which oppose each other in operation. Ideal conditions could not be prescribed from the findings of laboratory experiments, because these were designed to study specific plant processes as phenomena more or less detached from their agricultural concept and interpretation. Ideal conditions for crop production are virtually compromises between or among various opposing elements and represent essentially the best coordination which the circumstances permit of all important growth-affecting factors. The physiological basis of hydroponics lies in the functions of cultural technique and equipment, designed to obtain yields of crops which, when measured by the standards of the farmer, compare favourably with those of agriculture. Heretofore no comparison was possible because the scale of the water culture experimentation employed in plant physiology laboratories was far too small and restricted to warrant interpretation of data in the standard of the farmer's 'yield per area'. But more serious, however, was the fact that the ecological conditions created by the technique used was quite foreign to the natural pattern for plant growth, so that the data had very restricted interpretation and application. Essentially it was not the physical limitation of size of equipment used which obscured the productive potentiality of water culture, but rather that small size created unfavourable ecological conditions. These in turn created physiological limitations.

While the importance of climatic and ecological conditions to crop production is so widely and generally recognized that it seems presumptuous

to make allusion thereto, nevertheless, in view of the historic use of water culture in scientific studies, it appears not out of place to direct attention to the conditions under which the experiments were conducted, and invite comparison of the laboratory with that of Nature. Essentially, the temperature of the soil, except the surface layer, does not vary from day to day; the air temperature varies according to the diurnal changes of solar radiation. It follows, therefore, that the gradient of the root-top temperatures of the plants must change therewith. Complete reversal of gradient comes in the course of twenty-four hours wherever a marked difference prevails in the air temperature of day and night. It is obvious where plants are grown in small containers set on laboratory benches that either a maintained or changing temperature of the room creates a different ecological condition from that which exists in Nature with respect to the root-top gradient. The different parts of most economic plants do not have the same climatic requirements, and consequently cultural technique which exposed the different parts to the same temperature environment cannot be expected to favour growing conditions. The more or less rhythmic change in root-top gradient by virtue of change of the air temperature from day to night and constant root temperature, is an ecological condition that the laboratory climate did not provide.

Classical water-culture experimentation required pure or refined chemicals, pure water, and glass or glazed earthenware containers which resisted solvation. The nutrient solutions were therefore of fairly well-defined character and composition. Obviously these materials are economically prohibitive for economic use of water culture. Consequently investigation had to be undertaken to determine the suitability of ordinary and less expensive materials. Hitherto untried materials had to be studied: crude chemicals and ordinary ground water for the nutrient solutions; building materials—concrete, wood, sheet metal, and various plastics for containers; and various kinds of vegetable litter for the seed-bed.

The equipment must supply the functions of a fertile soil—supply vegetation with water, with the necessary elements, and provide support to hold the seed and growing crops in proper juxtaposition to the environment (Figs. 1 and 2); the feeding roots in the water, the root crown in moist porous media above the water, the leaves in the air.

Basins now in use are constructed of the following materials: concrete, wood, sheet metal (iron) and various asphaltic preparations. The concrete basins constructed as trays range from 2½ ft. to 6 ft. in width with 50 ft. as the maximum length of single units. In some cases units are joined end to end, making even longer basins. Also basins 50 ft. × 100 ft., providing continuous water surface of 5,000 square feet, are being tried. Wooden basins range from trough-like structures 1 foot wide and 40 feet long to flat tanks 12 feet wide and with length sufficient to provide 1/200-acre water surface in single units. Black iron sheet metal has proved serviceable for smaller basins; the largest used are 2½ feet wide and 10 feet long. Certain asphaltic preparations, where proper care was taken in construction, have made fairly serviceable equipment—that is, more or less durable. The depth of the basins range from 4 inches to 8 inches; 6 inches is probably the most satisfactory for most crops.

Remedial measures taken to overcome harmful substances in the materials were as follows. For the alkalinity of the concrete, leaching with water, treating with acid, and coating with non-toxic, water-resistant paints proved effective. For unknown organic substances that may diffuse from wood, brush treatment with strong alkali solution gave good results. Black iron sheet metal gave no trouble—it is conceivable that iron which has appreciable quantities of zinc, copper, manganese, nickel, and presumably other metals, would give trouble unless the iron is coated with a non-toxic paint or enamel. Some of the asphaltic preparations used were found to be toxic and care must, therefore, be taken in the choice of all asphaltic or bituminous materials which are used as plastics or to coat and waterproof equipment.

While the size of basins in the several plants was determined wholly from mechanical considerations, observations, however, have shown that size has physiological importance. This was suggested in several ways, but the information available does not yet warrant a definite statement.

The seed-bed is a mat of vegetable litter—excelsior, straw, sawdust, peat moss, etc., mounted over the surface of the nutrient solution. It rests on wire netting strongly secured to a portable frame. This rests on the top of the basins. The seed-bed provides support for the seed and growing plants, and by protection against sunlight inhibits the growth of algæ. It also protects against desiccation, and extreme temperature fluctuations. The nature and quantity of litter used reflects itself in the water-air properties of the seed-bed and thereby affects ecological conditions. The greater the amount of water that can be held in the seed-bed, compatible with good air supply therein and with other plant requirements, the less fluctuation will there be in the temperature of the roots and of the root-crowns of the plants with changes in the air temperature, because of the high specific heat of water. The root-crown requires different ecological conditions from the

feeding roots immersed in the solution. Classical technique with the plants held in the solution by a nonporous support precluded the attainment of these important conditions.

The elements essential to plant growth in liquid culture media are generally known. These elements can be grouped into three classes. First those required in fairly large amounts, which can be supplied in considerable excess without toxic effect, and each of which is absorbed in varying quantities, so that the composition of the plants will thereby vary; these elements are nitrogen, phosphorus, potassium, calcium, magnesium. Their range as possible variants in the plant composition must be considered in devising formulæ. In the second class is the element which can be supplied in large excess without toxic effects and is not absorbed in markedly varying amounts, hence is a minor variant in plant composition. This element is sulphur; the sulphate, therefore, becomes in effect a balancing agent. The third class includes the elements required in small amounts and which are toxic if the concentration exceeds certain low values—fractions of a part per million. These elements are iron, manganese, copper, zinc and boron.

The salts should be chosen so that mixtures

Fig. 1.
TANK OF TOBACCO.

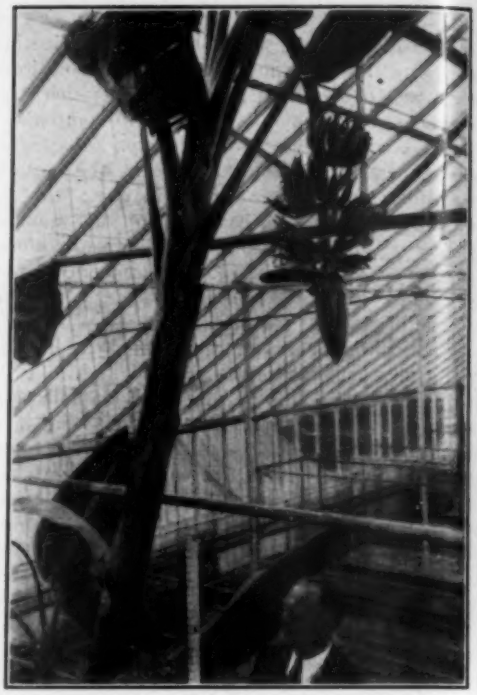

Fig. 2.
BANANA, ONE YEAR FROM BUD.

can be made which will conform in a general way to the proportions found in the composition of the plants, considered as the aggregate of the compositions of different parts. The salt which provides the cation required in largest amount shall provide the anion required in largest amount. Likewise the cation required in smallest amount can be supplied with the anion required in smallest amount, and for those elements between these extremes, the same principle holds. Thus, potassium nitrate, calcium phosphate, and magnesium sulphate are the chief commercial sources of the major elements. In the original experiments, magnesium phosphate and calcium sulphate were used instead of the last two of the above, but, inasmuch as the desired combinations can also be obtained from chemicals already extensively used as land fertilizers, the former set is recommended. Whenever it is desirable to have some combinations which the above three salts cannot provide, a fourth salt can be added; sulphuric acid is added to the mixtures to obtain any required reaction. Sulphates as already noted are not absorbed in great excess of the plants' need and, therefore, large quantities can be used if necessary. The sources of the minor elements is essentially immaterial, unless plant products relatively high in

Fig. 3.

TOMATOES, 4¼ MONTHS AFTER PLANTING.

some of these elements are desired. In such cases one would choose the least toxic forms, which in some cases would be organic compounds.

The purpose of having the nutrient solutions conform as nearly as possible to the composition of plants, is to preclude excessive absorption of certain elements causing an abnormal composition. The fact that plants vary as to composition is in itself evidence that nutrient solutions, somewhat different in chemical composition from those compounded by the principles stated above, will support plant growth with more or less satisfactory results. But excessive absorption of any element, especially in the early growth stage, may have unfavourable effects on subsequent plant activities. On the other hand, the early growth stage is also most labile, permitting use of stimulatory conditions which can be very beneficial if not too greatly prolonged. For example, a relatively large supply of certain elements in the culture during the early growth stage, which in case of nitrogen could be supplied both as cation and anion, and more or less complete absence of them in the latter growth period, will be more effective for certain crops than a maintained supply—the quantity absorbed being equal in both cases.

Answer to the question "How much plant food shall be added to a given quantity of water?" can be given by the description of experiments with some of the crops, for example, with tomato (Fig. 3): 20 plants set in a basin 10 feet long, 2½ feet wide, and 8 inches deep (thus 16⅔ cubic feet of water) received nutrients in 1-pound lots, supplied as a mixture of dry salts. When the plants were about two months old, the nutrients were practically exhausted and then another pound was added. Subsequent additions were made at shorter intervals, 7 pounds being the total amount supplied; but the solution was exhausted two months before the experiments were concluded, being then one year old. (The average yield of ripe fruit per basin was 306 pounds—more than five sixths of the total was harvested nine months after planting. There were four basins, each a different treatment; the largest yield was 532 pounds. The basins, including space between, occupied 130 square feet of greenhouse floor.) No difference was noted when smaller applications were made at frequent

Fig. 4.

HARVEST OF 1/100-ACRE POTATO CROP, 18 WEEKS AFTER PLANTING.

intervals or larger applications at less frequent intervals. Apparently any concentration within the range defined for the lower limits of about half a pound, and the upper limit of about two pounds per 16 cubic feet of water, gives satisfactory results. This means that the stirring in of additions of nutrients was not necessary; the mixture was merely added at one point. Obviously there is a practical limitation to the distance salts will diffuse and consequently appropriate means must be employed where large basins are used.

A field of 1/100 acre area planted to potatoes produced a yield of 24·65 bushels, or 1,479 pounds (Fig. 4); 40 lb. of chemicals was used. This experiment was in 1934. In subsequent trials each year thereafter, the above-stated large yields were not obtained; apparently certain features of the techniques, ideal in 1934, did not produce ideal growing conditions in the subsequent tests. I believe, however, that the technique can be designed to obtain consistent results with the potato.

The retail market price of the chemical used in largest amounts, and the most costly, namely potassium nitrate, was 70 dollars per ton. Chemicals were of the grade used in compounding fertilizers for land.

The greatest item of cost in crop production by hydroponics is the investment in basins. Also the cost of the chemicals will be a major item in some crops. For example, about two pounds of chemicals were required to produce four pounds of dry wheat grain. Even though the yield per unit area of water surface in basins of the size mentioned for tomatoes was exceptionally high (computed to acre basis it was 142 bushels), the ratio of the quantity of plant food required (at first glance one may think this quantity too high; the weight of oxygen accounts for the apparent large quantity of plant food required) to that of yield obtained makes the cost of production of wheat and other crops that are predominantly 'dry matter' prohibitive by water culture under present conditions. Crops the marketable products of which are characterized by high water, starch, or sugar content, give promise in an economic appraisal of production by hydroponics.

It is, of course, not inconceivable that industry may develop and manufacture equipment at markedly greater economy than prevails at present, thereby increasing the number of crops that can be grown economically.

There are no specific formulæ or cultural techniques that can be prescribed to be followed too literally because of the somewhat unknown character of the materials and equipment that will be used; cultural technique must be designed to meet the conditions where the crops are grown. The principle of making the adjustments, the elucidation of the physiological basis for all features of the method, together with concrete description and data of experimental plants, need to be made available for the guidance of prospective hydroponicists. To provide this is the programme of research now being pursued.

[1] Gericke, W. F., "Aquiculture—A Means of Crop Production", *Amer. J. Bot.*, **16**, 862 (1929).

[2] Gericke, W. F., "Hydroponics—Crop Production in Liquid Culture Media", *Science*, **85**, 177 (1937).

Centenary of the Atlantic Steam Ferry

IN April 1838, the paddle steamer *Sirius*, 703 tons gross, won for herself the distinction of being the first vessel to cross the Atlantic Ocean under continuous steam power. To celebrate the centenary of this notable achievement, a special exhibition, "One Hundred Years of Transatlantic Steam Navigation", is being held at the Science Museum, South Kensington, and will be open until mid-September, to show in outline the developments that have marked the growth of this service. An illustrated handbook bearing the same title (London: H.M. Stationery Office. 6*d*. net) prepared by Mr. H. P. Spratt, the Museum officer responsible for the organization of the exhibition, gives a brief account of the history of the Atlantic steam ferry together with descriptive and historical notes on each of the steamships represented. These exhibit the striking developments which have taken place in naval architecture and in the methods of steam propulsion.

The change from wooden hulls, first to wrought iron construction and finally to steel, is exemplified in the size of the vessels and in new methods of construction. Paddle wheel propulsion gave way to single screws; twin, triple and quadruple screws followed in quick succession. The early engines derived most of their power from the condensation of the steam, and the nature of the evolution was first to simple expansion engines and then to compound, triple and quadruple expansion engines which, in their turn, have been superseded by the Parsons direct-drive, then single-reduction and now double-reduction turbines. It is to be remembered that each of these developments has

been due not only to the progress of design but also to the improvements in ancillary departments, such, for example, as the manufacture and treatment of steel and other materials and in the production of accurately cut gears. As a means of visualizing the increase in size of the vessels, it is pointed out that the hull of the *Britannia*—the first of the Cunarders, 1,156 tons, built in 1840 at Greenock—could be fitted into the restaurant and foyer of the R.M.S. *Queen Mary*.

A visit to the exhibition is most instructive, as it epitomizes in the models which have been gathered together from various sources these and other aspects of the technical developments which the century has witnessed. A visit is the more desirable in that such an opportunity of seeing so many closely related models in so favourable a setting can only occur at rare intervals. As the models are, with a few special exceptions, to the same scale of 1 to 48, it is possible to obtain a clear idea of the relative sizes and forms of these historic vessels. Among them are several foreign ships, notably the *Bremen*, the *Conte di Savoia*, and the *Normandie*, while another exhibit which has a special importance as the representative of steam's competitor in ship propulsion is the model of the Swedish diesel motor-liner *Gripsholm*. The *Conte di Savoia*, built at Trieste in 1931, was the first Atlantic liner to be fitted with gyroscopic stabilizers. These were made in England and the installation is calculated to limit the roll of the ship to 3° on either side of the vertical.

As to which is the most interesting vessel represented, opinions differ, but the *Great Eastern* (1858) has some claim as being a premature leviathan conceived and built forty years or so in advance of practical experience. She was designed by Brunel and was about five times the size of any then in use. Built at Millwall, many unsuccessful attempts were made to launch her, and finally she was launched sideways into the Thames. A unique feature was that she was propelled both by paddle wheels and a screw propeller. The paddle engines of 3,411 I.H.P. had four oscillating cylinders and received steam at 24 lb./in.² from four double-ended tubular boilers of box pattern. The screw engines of 4,886 I.H.P. had four horizontal direct-acting cylinders and received steam at 25 lb./in.² from six double-ended tubular boilers. Though she had no commercial success as a liner, she did most valuable work between 1865 and 1873 in laying a number of submarine cables. Not until the *Oceanic* was built in 1899 was the size of the *Great Eastern* exceeded.

As a further mark of the importance of the occasion, a lecture entitled "The Centenary of Transatlantic Steam Navigation" was delivered before the Newcomen Society at the Science Museum on March 16 by the president, Engineer Captain E. C. Smith, in which he dealt particularly with the construction and experiences of the early vessels on this service. Prior to 1838, many voyages across the Atlantic had been made by steam-engined vessels, but so far as it is known, all were made partly under sail. The first three to cross by steam power were the *Sirius*, built for the London and Cork service, which arrived off New York on April 22, 1838, the *Great Western*, built for the Atlantic service, which arrived on the next day, and the *Royal William*, also built for the Atlantic, which after some misfortunes completed the crossing on November 23. These vessels were, in a sense, sailing ships, as they carried sail and took advantage of the wind, but they were intended when necessary to steam against wind and sea. Therefore, although in effect sailing ships fitted with engines, they embodied important constructional modifications so that they could carry the machinery stresses and bear the severe shocks inevitable in a seaway. Sleepers or platforms were built in to carry the boilers and engines, strong beams were necessary to support the paddle shafts and the sponsons housing the paddle wheels. Sir Robert Seppings, surveyor to the Navy, was responsible for many of the devices adopted, and it was he who introduced a method of fitting the frames close together and caulking them to form a solid hull before the external planking was fixed. He also devised an arrangement of internal diagonals, which later took the form of diagonal iron bars, so as to make the hull a rigidly trussed structure.

Early engines were very similar to the land engines made by Boulton and Watt, of the two cylinder side-lever type with cranks at right angles, and used steam at a pressure of 2–5 lb./in.² Condensers were essential at first as the bulk of the power was derived from the vacuum; later they were discarded and afterwards were reintroduced. Sea water was used in the boilers, which were practically rectangular tanks with internal flues. It was an important duty of the engineer to keep the density of the water low to prevent incrustation. Three methods were in use, the earliest being to stop the engines every third or fourth day, empty the boilers and refill from the sea. This was superseded by frequent blowing down which, in turn, gave place to the use of brine pumps.

The reprint of the lecture contains extracts from the "Field Papers" preserved in the Science Museum Library, which give much information not obtainable elsewhere on this subject.

A contemporary view of the prospects of the Atlantic crossing under steam appears on p. 566 of this issue.

Obituary Notices

Mr. T. W. F. Gann

WE regret to record the death of Mr. Thomas William Francis Gann, archæologist and explorer of Central America, which took place in London on February 24, in his seventy-first year. He was the son of William Gann of Whitstable, and was born at Murrisk Abbey, Co. Mayo, the home of his mother, who before her marriage was Miss Rose Garvey.

Gann was educated at King's School, Canterbury, and at Middlesex Hospital, where he qualified as M.R.C.S. and L.R.C.P. in 1890. Later he went to Central America with a medical expedition to relieve distress after an earthquake in Guatemala, and from that time forward his life was devoted to Central American studies. He entered the Government service of British Honduras at Belize, becoming in due course principal medical officer of the colony and a member of the Legislative Council.

Although Gann was keenly interested in the study of tropical medicine, he was even more deeply devoted to study of the archæology of the Mayan civilization of Central America. Taking advantage of the numerous journeys to various parts of the colony, which it was necessary for him to make, he explored the country for previously unrecorded ruins, at the same time observing the character and customs of the natives, which he appreciated might serve to throw light on the peoples of the ancient civilization. It was not long before he was recognized as an authority on Central American archæology. He contributed papers to the British Association and the publications of the Smithsonian Institution of Washington, and later was appointed lecturer on Central American archæology in the University of Liverpool. In 1926 he represented the British Government at the International Congress of Americanists in Rome.

After the Great War, Gann's work, already recognized by specialists, became more widely known through the travel books of a semi-popular character which appeared annually over a number of years. In each of these he described a journey of archæological exploration which he had made in the preceding year, and on nearly every occasion he had some outstanding discovery of previously unknown ruins to record. Of these, one of the most remarkable was the city of Coba, with its wonderful stone causeway of approach, extending for many miles. He also discovered some important date-inscribed stelæ, one of which was deciphered as giving the earliest date in Mayan chronology then known. As Captain T. A. Joyce has pointed out, it was owing to his interest in following up rumours of ruined cities in the depths of the tropical forest that attention was directed to the remarkable series of stone buildings which link the temples of Yucatan to the ancient Mayan centres of Guatemala and Honduras. Gann also shared in the work of the British Museum's expedition, of which Captain Joyce was in charge, when the great ruins of Lubaantum, Pusilhà and Minanhà were excavated and explored. An explorer rather than an excavating archæologist, owing mainly to lack of opportunity, Gann was conspicuously generous in placing his knowledge at the services of others whose opportunities were more favourable. His collections enrich both the British Museum and the Liverpool Museum.

In addition to the series of volumes recording his journeys of exploration, and papers in the journals of learned societies, Gann was the author of a number of works dealing with Central American archæology and prehistory, of which the latest was "Mexico from the Earliest Times to the Conquest" (1936). With J. Eric Thompson he also wrote "A History of the Maya" (1931).

Dr. Francis G. Pease

THE Mount Wilson Observatory has suffered a severe loss by the death on February 7, at the age of fifty-seven years, of Dr. Francis G. Pease.

For many years Dr. Pease was in charge of instrument design at the Observatory. When the United States declared war in 1917, he became chief draughtsman to the National Research Council, Washington. He gave a great deal of thought to the design of very large telescopes, and his investigations showed that the construction of a 200-in. telescope presented no insuperable difficulties: he has been closely associated with the design of this telescope, which is to be erected on Mount Palomar.

Dr. Pease did a great deal of nebular photography, and many of his beautiful photographs of nebulæ are celebrated. He determined the line-of-sight velocities of a number of the extra-galactic nebulæ and investigated the rotation of some of them. In association with Dr. W. S. Adams, the spectra of various novæ were obtained after the novæ had become faint, and the novæ were shown to have become Wolf-Rayet stars.

Dr. Pease collaborated with Prof. Michelson in the application of the interferometer to the measurement of stellar diameters. With a special interferometer, 20 ft. in length, mounted on the end of the tube of the 100-inch telescope, he succeeded in measuring the angular diameter of Betelgeuse on the night of December 13, 1920, a memorable observation because it was the first measurement of the diameter of a star ever made. The measures of stellar diameters with this interferometer, and afterwards with a specially constructed 50-ft. interferometer telescope, have mostly been made by Dr. Pease. They demanded considerable skill in adjustment and great patience, qualities which Dr. Pease possessed in a unique degree.

When Prof. Michelson repeated the famous Michelson-Morley experiment with a large steel and invar interferometer in the years 1927–29, Dr. Pease collaborated in the observations. The purpose was to investigate the possible ether-drift which D. C. Miller claimed to have established. No displacement

of the fringes so great as one fiftieth of that to be expected if such an ether-drift existed was obtained.

Dr. Pease was working with Prof. Michelson on the measurement of the velocity of light, in a pipe-line one mile in length evacuated to a pressure of a few millimetres, when Prof. Michelson died in May 1931. This investigation was then placed under the direction of Dr. Pease, who succeeded in holding a pressure of 2–3 mm. in a line built up of 60-ft. sections of steel pipe, 3 ft. in diameter. Multiple reflections from mirrors at the two ends of the pipe-line increased the effective length of path. The mean velocity obtained from several sets of measures, comprising in all 2885 determinations, was 299,774±11 km./sec., which must be regarded as the best determination of this velocity. H. S. J.

Prof. Max Neisser

THE death on February 25 of Prof. Max Neisser in his sixty-ninth year creates another blank in that distinguished roll of German bacteriologists who have occupied chairs of hygiene modelled on the Koch tradition. The name of Neisser bulks largely in bacteriological literature. Albert Neisser of Breslau, the discoverer of the gonococcus, was an uncle of Max; and the veriest tiro in bacteriology is, at a very early stage, introduced to at least one achievement of the latter—the Neisser stain for *C. diphtheriæ*.

Born in 1869 at Liegnitz in Silesia, Max Neisser removed with his parents to Berlin, where he received his schooling and his medical training. The work involved in the preparation of his thesis for the doctorate in medicine, which he obtained in 1893, was carried out in Rubner's laboratory. In 1899 he met Paul Ehrlich—a great event in his life. In the same year he went to Frankfort-on-Main, where he was given charge of the department of bacteriology and became a professor in 1901. In 1909 he was appointed director of the new Städtisches Hygienisches Institut, later to be named the Städtisches Hygienisches Universitäts-Institut when the University of Frankfort was founded in 1914.

During the Great War, Neisser did valuable service first in a field dressing station and later as a consultant on hygiene.

When the War ended, Neisser returned to his professorial duties, resumed his scientific work, and took a prominent part in the organization of public hygiene in Frankfort. In April 1933 he retired, at the age of sixty-three years, and has since held the title of professor emeritus.

Since he embarked on his research career forty-five years ago, Neisser has been a most devoted and assiduous student, and his contributions, which cover a surprisingly wide range, embracing bacteriological, immunological and hygienic studies, have been many. Before me is a list of no fewer than 156 titles of contributions by him in the period 1893–1935. Here I can do no more than refer briefly to some of the more outstanding achievements to his credit in the field of bacteriology and immunology.

His sojourn at Breslau under Flügge in the closing years of the nineteenth century gave Neisser an opportunity of studying what was then a very acute and pressing problem, the differentiation of diphtheria bacilli from other diphtheroids, and the elaboration of a working technique for use in institutions concerned with the diagnosis of diphtheria.

The well-known Neisser stain for demonstration of the metachromatic bodies in diphtheria bacilli dates from this period. As one of Ehrlich's band of workers in the Frankfort Institute, Neisser, with his colleague Wechsberg, took a prominent share in those pioneer studies conducted under Ehrlich's guidance on the nature and mode of action of hæmolysins, antitoxins and bactericidins in immune sera during the early years of the present century. The Neisser-Wechsberg phenomenon (1901), which disclosed the fact that excess of immune body in relation to available complement interfered with bactericidal action, was an important outcome of this period of his activity. Its precise mechanism is perhaps not even now elucidated and may have to await progress in the physico-chemical attack now being made on the nature of antigen-antibody combinations.

Neisser devoted much attention to the elaboration of accurate plating technique for evaluating bactericidal action, and in connexion with the staphylococcus, on which he wrote widely, he explored with Wechsberg the possibility of detecting by aid of methylene blue the killing power of staphylococcal leucocidin on leucocyte suspensions (so-called bioscopic method).

In 1903 Neisser's demonstration of the fact that influenza bacilli can be grown on ordinary agar in symbiosis with *B. xerosis* is of considerable historical interest in the light of later developments in our knowledge of the essential growth factors of the hæmophilic group of organisms.

In 1906 a most interesting and fruitful field in bacterial variation was opened up by Neisser's observations on an organism (*B. coli mutabile*) which, when grown on lactose-agar, was capable of throwing off variants endowed with the power of fermenting lactose. The analysis of this 'mutation' phenomenon, pursued by Massini and Reiner Müller and particularly by Penfold in Great Britain, added much to our knowledge of variation phenomena in bacteria, in so far as their fermentative properties are concerned.

During the period of his directorship of the Hygienic Institute (1909–33), Neisser's activities, so far as one may judge from the titles of his numerous papers, were, for the most part, bound up with problems of public hygiene over which he freely ranged, the care of the tuberculous, milk provision, bacteriological water analysis, disinfection and water purification being particularly favoured subjects. In the later years of his directorship he devoted much attention to the possibilities of water purification by employing the bactericidal action of silver ions.

There can be no doubt that Max Neisser was an unusually gifted and versatile occupant of the first Frankfort chair of hygiene, beloved of his students and ever ready to spend himself freely in furthering every project likely to raise the standard of public hygiene in the city of his adoption. J. C. G. LEDINGHAM.

Dr. Gilbert Slater

WE regret to record the death of Dr. Gilbert Slater, the economist and an authority on the culture and village life of southern India as it existed twenty years ago, which took place at Oxford on March 8 at the age of seventy-three years.

Slater was born in Plymouth on August 27, 1864, the son of Daniel Slater, a schoolmaster. A member of St. John's College, Cambridge, he was also a D.Sc. in Economics of the University of London, a degree to which, however, he was admitted so late as 1905. After leaving Cambridge he was for a time a schoolmaster; but he left the profession to take up lecturing, social work and political activities. In 1905 he was elected the first Labour mayor of Woolwich. The publication of his doctor's thesis in enlarged book form under the title "The English Peasantry and the enclosure of Common Fields" (1907) led to his appointment as head of Ruskin College, Oxford, in 1909. Here he remained until 1915, when he accepted the newly founded chair of Indian economics at the University of Madras. In 1921 he became publicity officer for Madras and a member of the Legislative Council. Slater returned to England in the following year, and in addition to lecturing at the London School of Economics and to Indian Civil Service students at Oxford, wrote a number of books on social and economic subjects, among which may be mentioned "The Growth of Modern England" (1932) and a final work on India, "Southern India, its Political and Economic Problems" (1936), as well as a chapter on the social and industrial history of Kent in the Victoria County History.

Of Slater's more active years, viewed in relation to scientific thought, the period which he spent in India was the most productive and influential. "Some South Indian Villages" (1917), which he edited, was based on surveys made by his students, whom he sent out with a questionnaire of his own devising to make first-hand observations of conditions in the villages with which each was well acquainted by residence. These intensive studies produced a mass of ethnographic and economic data, variable in quality, it is true, but of very considerable value. In the final form given by the editor, this report has had a profound effect on subsequent Indian political and sociological theory and practice. His analytical faculty also turned to the study of Indian culture and in his "The Dravidian Element in Indian Culture", published in 1923 after his return to England, he gave an orientation to the study of the place of the Dravidians in the development of Indian civilization, which, like his work on the Indian village in its special field, has greatly influenced the development of later Indian studies, although in directing attention to and emphasizing the affinities of the Dravidian and Mediterranean peoples, he was developing ideas already adumbrated by Mr. F. J. Richards, as Dr. A. C. Haddon has pointed out (see "The Races of Man", by A. C. Haddon, 1924, p. 150, where Slater is, curiously, miscalled "Scott").

Mr. F. J. Hanbury

MR. F. J. HANBURY, who died on March 1 at the age of eighty-six years, was the son of Cornelius Hanbury, of the firm of Messrs. Allen and Hanbury, wholesale druggists. He was educated at the Friends' School, Tottenham, and afterwards studied pharmacy, passing with honours the two examinations of the Pharmaceutical Society. He joined his father's business in 1872, becoming a partner and eventually chairman of the firm in 1916.

In the 'eighties Mr. Hanbury formed a friendship with the late Rev. E. S. Marshall and became interested in British flowering plants. The two explored the northern Scottish Highlands together, and Hanbury began a study of the difficult genus *Hieracium*. Of this group he described several new species, and in 1889 published the first instalment of a sumptuously illustrated monograph. Before this work had proceeded far, however, it was found impracticable to continue it in the manner contemplated, and it was abandoned. Mr. Hanbury then turned his energies to the production of a flora of Kent, with Marshall as collaborator, and this was completed and published in 1899.

From this date Hanbury did little further botanical work, but he continued to act as editor of the "London Catalogue of British Plants". For some time he took a keen interest in entomology, but after his removal to East Grinstead he devoted himself to the development of his magnificent garden and the cultivation of tropical orchids. He was a prominent member of the Royal Horticultural Society, serving on the scientific and other committees, and was a recipient of the Society's Victoria Medal of Honour. He was almost the 'father' of the Linnean Society, which he had joined in 1873. He recently presented to the Botanical Department of the British Museum (Natural History) the important herbarium of Dr. Boswell Syme, which he had acquired many years previously.

H. W. PUGSLEY.

WE regret to announce the following deaths:

Prof. J. E. Coover, emeritus professor of psychology in Stanford University, on February 19, aged sixty-five years.

Sir Raymond Crawfurd, registrar of the Royal College of Physicians of London, known for his work on the history of medicine, on March 9, aged seventy-two years.

Sir Reginald Fleming Johnston, K.C.M.G., C.B.E., formerly commissioner for Wei-hai-wei, an authority on the Chinese language and people, on March 6, aged sixty-four years.

Major A. D. Lumb, of the Scientific and Technical Department of the Imperial Institute, known for his work on the geology and mineral survey of southern Nigeria and the Udi Okana coalfield.

Prof. A. Magnan, professor of animal mechanics applied to aviation in the Collège de France, aged fifty-seven years.

Mr. Melville Hilton-Simpson, the distinguished traveller and ethnologist, on March 17, aged fifty-seven years.

News and Views

New Fellows of the Royal Society

At the annual election of fellows of the Royal Society held on March 17, the following were elected: G. D. Bengough, consultant to the Chemical Research Laboratory, Department of Scientific and Industrial Research; C. H. Best, professor of physiology, University of Toronto; W. Brown, professor of plant pathology, Imperial College of Science and Technology; J. W. Cook, professor of chemistry, The Research Institute, Royal Cancer Hospital; T. L. Eckersley, research physicist, Marconi's Wireless Telegraph Co.; G. I. Finch, professor of applied physical chemistry, Imperial College of Science and Technology; W. E. Gye, director of the laboratories of the Imperial Cancer Research Fund; W. V. D. Hodge, Lowndean professor of astronomy and geometry, University of Cambridge; J. S. Huxley, secretary of the Zoological Society of London; J. Jackson, H.M. Astronomer at the Cape; Sir Robert Mond, chemist and Egyptologist; J. E. Richey, district surveyor, H.M. Geological Survey; F. S. Russell, naturalist at the Marine Biological Association; B. F. J. Schonland, professor of physics, University of Cape Town; F. S. Sinnatt, director of fuel research, Department of Scientific and Industrial Research; K. M. Smith, senior research assistant, Plant Virus Station, Cambridge; E. Stedman, lecturer in the Department of Chemistry in relation to Medicine, University of Edinburgh; C. E. Tilley, professor of mineralogy and petrology, University of Cambridge; W. E. S. Turner, professor of glass technology, University of Sheffield; H. H. Woollard, professor of anatomy, University College, London.

Presentation to Sir Arthur Harden

At the annual general meeting of the Biochemical Society held on March 11, a presentation was made by the Society to Sir Arthur Harden, on the occasion of his retirement from the editorship of the *Biochemical Journal*. The presentation took the form of an inscribed salver, bearing the signatures of all those still living who have served on the Committee of the Society during the twenty-five years of Sir Arthur's editorship. In making the presentation on behalf of the Society, the present chairman of committee, Prof. H. J. Channon, recalled the early history of the *Biochemical Journal*. Founded by Prof. Benjamin Moore and Mr. E. Whitley in 1906, it was first issued as a private venture from the Department of Biochemistry in the University of Liverpool. In 1911, at the instance of Dr. (now Prof.) R. H. A. Plimmer and Mr. J. A. Gardner, there was formed an organization of biochemists, called at first the Biochemical Club, the members of which soon came to feel the need for a journal to cover the widest interests of the growing science of biochemistry in Great Britain; negotiations were therefore started which led, in October 1912, to the acquisition of the *Biochemical Journal* by the Biochemical Club, which at the same time changed its designation to Biochemical Society; the editors appointed by the newly formed Society were Arthur Harden and William Bayliss. Prof. Channon traced the remarkable growth of the *Biochemical Journal* from its modest beginning to its present position as one of the outstanding biochemical publications of the world, and in thanking Sir Arthur for his great services to the Society he paid an eloquent tribute to his qualities as an editor.

In supporting Prof. Channon, Sir Frederick Gowland Hopkins emphasized the importance of Sir Arthur Harden's own work in influencing the development of biochemistry in Great Britain, and the advantage which had accrued to that science in its early days from the entry into it of an accomplished chemist. Sir Frederick referred to the sacrifice of time involved for an active investigator in editing a scientific journal; but pointed out that, regrettable as such loss of time might be, it was only an active investigator who could give full and sympathetic understanding to the difficulties of his colleagues in presenting the results of their researches; such understanding Sir Arthur had always given in full measure. Sir Arthur Harden, in acknowledging the presentation, expressed his appreciation of the help which he had received from his various co-editors. Sir Arthur stated his conviction of the importance of free and reasonably detailed publication of results in the development of a growing science such as biochemistry and indicated the way in which as an editor he had attempted to give effect to this conviction. The occasion of the presentation constituted something of a landmark in the history of biochemical publications in Great Britain since the increasing size of the *Biochemical Journal* has necessitated a further subdivision of the editorial work. It will be hoped by all who are interested in the progress of biochemistry that it will be possible under the new arrangements to maintain the high standard which has been reached as the result of Sir Arthur Harden's work during the past twenty-five years.

Dr. W. H. Pearsall

Dr. W. H. Pearsall, whose appointment to the chair of botany at Sheffield has recently been announced, was educated at Ulverston Grammar School and the University of Manchester, where he continued his studies after graduation. In 1921 he was awarded the D.Sc. for his work on the aquatic vegetation of the English Lakes. During the Great War he served with a battery of the Royal Garrison Artillery and later with the Royal Engineers. He

joined the staff of the Botany Department at the University of Leeds in 1919 and was appointed reader in 1922. Dr. Pearsall has taken an active part in many scientific societies; he acted as secretary to the Society for Experimental Biologists in 1928–33, and has just completed his term of office as president of the British Ecological Society; this year he has also taken over the editorship of the *Journal of Ecology* from Prof. A. G. Tansley. He acted as joint secretary of the Yorkshire Naturalists' Union with the late Mr. F. A. Mason in 1919–29 and since 1933 has been co-editor of *The Naturalist* with Mr. W. R. Grist; in 1937 he served as president of the Union. From 1931 until 1937 Dr. Pearsall acted as honorary director of the Freshwater Biological Station at Wray Castle, Windermere, where he has taken an active part in organizing most successful short courses in freshwater biology for senior university students; his guidance has also been of great value to a series of investigators, who have studied problems of freshwater biology at this centre.

DR. PEARSALL'S published scientific work has been mainly upon problems of ecology and upon various aspects of the physiology of growth in plants, with especial reference to problems of nitrogen nutrition. His work, with which his father was associated at its inception, upon the freshwater biology of the English Lakes, is very widely known. It has provided an admirable basis for many of the more intensive investigations that can now be attempted with the establishment of a permanent centre of investigation upon Lake Windermere. Dr. Pearsall's interests in ecology have ranged very widely; his recent presidential address to the British Ecological Society dealt especially with soil factors in relation to plant distribution. The importance of the oxidation-reduction potential is stressed, and Dr. Misra under his guidance has recently shown the significance of this factor in connexion with the mud deposits in the Lakes. Dr. Pearsall's studies upon plant metabolism have been linked up with his extensive studies of the growth of algæ, especially *Chlorella*, in pure cultures. This work has been extended recently with the aid of a grant from the Leverhulme Fund, but already many studies of plant metabolism have been published by Dr. Pearsall and his students in the last few years, including (with Dr. M. C. Billimoria) some very suggestive notes upon nitrogen loss from plants.

Atlantic Meteorology and Trans-Atlantic Flight

MR. F. ENTWISTLE, head of the Overseas Division of the Meteorological Office, Air Ministry, delivered the Symons Memorial Lecture before the Royal Meteorological Society on March 16, taking as his subject, "Atlantic Flight and its bearings on Meteorology". Mr. Entwistle stated that the success of the flights across the North Atlantic last year by Imperial Airways, Ltd., in conjunction with Pan American Airways, Inc., was due in very large measure to the thorough preparations which preceded them and to the ground organization, including radio and meteorological services, which was provided. The preliminary investigations carried out by the Overseas Division of the Meteorological Office in order to provide essential operational data before the flights commenced were described. The first investigation, commenced early in 1936, had as its object the determination of the maximum average head wind component that would be experienced on an east to west track along the great circle route between Ireland and Newfoundland. The results, which were based on an examination of data covering a period of ten years, indicated that while the maximum wind speed likely to be encountered at any point was 95 m.p.h., the maximum average speed over the whole route was 60 m.p.h. This average speed, however, occurred only once in ten years, and if, in the operation of a trans-Atlantic aircraft, an allowance was made for a maximum head wind on the east–west track of 40 m.p.h., there would be very few occasions in any one year when it was necessary to cancel the flight. A more comprehensive investigation followed in which the times of flight of aircraft of different air speeds on alternative trans-Atlantic routes were compared.

LATER investigations were concerned with the meteorological conditions affecting the operation of aircraft in Newfoundland, the variation of wind with altitude over the North Atlantic and the frequency and minimum heights of low cloud. For one year from November 1936 a technical officer of the Overseas Division of the Meteorological Office was attached to the *Manchester Port*, a cargo ship operating between Manchester and Canada. He completed eight round voyages, in the course of which he made regular pilot balloon observations to determine the wind speed and direction at different altitudes, constructed daily weather charts from observations received by radio from Europe and North America as well as from ships at sea, and studied in detail the characteristics of the Atlantic disturbances through which the ship passed. These investigations, which are essential to the supply of accurate meteorological information for trans-Atlantic flying, will benefit meteorological science generally and, in particular, the weather forecasting services of the countries of western Europe, the greater part of the weather of these countries developing over, and moving from, the Atlantic. The development of long-distance air routes in various parts of the world is stimulating similar meteorological activity and is providing data for investigation on a scale hitherto unknown.

Air-Raids on Barcelona

LAST week in the House of Commons, Mr. Chamberlain expressed his own and indeed the general view of the recent air-raids on Barcelona when he said that no one could read the reports "without horror and disgust". This feeling must be aroused by the whole practice of bombing from aircraft, especially from great heights, for it is inevitable that there should be loss of many innocent

lives and destruction of buildings of no military significance such as universities and scientific and other learned institutions. In this connexion we have received a copy of the following cable from the "Subsecretario Instruccion Publica" addressed to the president of the Royal Society of Medicine: "The Regular Air Force of Germany and Italy is demolishing the cities of Spain. The University of Barcelona like the Cajal Institute in Madrid has been almost completely destroyed. The same has happened to other centres of culture. During the last three days of terrible and continuous bombing, more than a thousand people were killed in Barcelona alone. We Spaniards of liberal and democratic convictions who only devote ourselves to literary and scientific activities protest against these monstrous crimes. At the same time we appeal to the sensitivity of our English colleagues and ask for their help in the defence of the independence of our country as well as of the universal principles of humanity, justice and law which the Spanish Republic implies. We ask you to bring to bear all your influence on the British Government so that it may take steps to avoid these barbarous atrocities, which are directed not only against defenceless human beings but also against the civilization and peace of the world. Jacinto Benavente (Nobel Prize); Ignacio Bolivar (naturalist); Pio Del Rio Hortega (biologue); P. Bosch Gimpera (archeologue); Enrique Moles, D.Sc.; Jose Xirau, D.L.; A. Duperier, D.Sc."

Exhibition of British Archæology

THE exhibition illustrating finds in Britain and Northern Ireland in the course of archæological exploration during the last five years at the Institute of Archæology of the University of London, Regent's Park, London, which was opened by Sir Charles Peers on March 21, is unique and the occasion historic. No exhibition of the kind has been held before, nor has so widely varied a collection of archæological material been assembled for temporary exhibition previously. Considering the relatively brief period during which the work of excavation has been carried out, the exhibition shows a remarkable and healthy activity in practical archæological study in Great Britain such as, it is probable, could not be parallelled elsewhere. The area covered includes England, Scotland, Wales and Northern Ireland, and the exhibits are drawn from sites in more than thirty counties. In time they range from the pre-glacial industries of East Anglia to Stuart pottery from the ditch of the Tower of London, lent by the Office of Works. Among the sites of major importance represented are Verulamium, of which the close of excavation just comes within the period, Miss Kenyon's excavations at the Old Jewry Wall of Leicester, with its evidence of Belgic occupation, and Dr. R. E. Mortimer Wheeler's exploration of Maiden Castle, with the interesting evidence of cannibalism and the remains of the last defenders of the fortress in A.D. 43. Material which should prove of intense popular interest is that from Castle Dore in Cornwall, which removes King Mark, father of Iseult, from the category of legendary figures and makes him a historical personage. Recent activities in, and discoveries by, air photography are well displayed. The exhibition will remain open daily from 11 a.m. to 4 p.m. until May 2.

Electron Diffraction and Surface Structure

IN opening the discussion on electron diffraction and surface structure before a joint meeting of the Physical and Chemical Societies held on March 17, Prof. G. I. Finch compared electron diffraction with other methods of surface structure examination, and cited cases where the microscope or X-rays may give a wrong impression of the structure of deposits and of the size, shape and chemical nature of thin crystalline films. He described, among others, a striking experiment on the orientation of fatty acids by friction, which seems to have a direct bearing on the nature of the mechanism of lubrication. Thus the previously unorientated molecules in a stearic acid layer deposited on a metal surface can be made to point in a common direction by rubbing. If the surface be rubbed in all manner of ways, it is the last stroke only which determines the final direction of orientation of the stearic acid chains. Prof. Finch also gave an account of new experiments which confirm the conclusions previously arrived at by electron diffraction as to the structure of the polish layer on calcite. Sodium nitrate crystals were found to orientate in such a way as virtually to continue the structure of calcite when deposited on the polish layer on a cleavage face and which electron diffraction had shown to be of single crystal structure integral with the main crystal. A calcite surface cut and polished in such a manner as to be steeply inclined to all cleavage planes, however, gives a halo pattern characteristic of an amorphous layer, and on such a surface the nitrate crystals do not orientate but point in all directions just as they do when grown, for example, on a glass surface. After heating, which causes this amorphous polish layer to recrystallize, the sodium nitrate crystals orientate once more.

The Fulham Power Station

THE Institutions of Civil Engineers and Electrical Engineers had a joint meeting on March 22 to discuss the new Fulham Power Station, which when complete will be the largest municipally owned base-load station in the British Isles. The station lies east and west, with the boiler house on the east, and is situated 60 ft. from the river frontage along the west bank of the Thames from Wandsworth Bridge. The first half of the paper was written by J. F. Hay and describes the constructional work, and the second half, by W. C. Parker and H. Clarke, discusses mechanical and electrical considerations. A point which has come prominently forward during recent years is the necessity of having as wide a specification as possible for the coal used. The effect of having two of the base-load stations on the Thames equipped with the same kind of stoker and similar methods of feeding is making a considerable demand for a special type of coal from the coalfields, and this both increases

the price of this type of coal and brings about a shortage of supply for it. The Ministry of Health requires constant tests to be made of the sulphur content of the flue gases, but the difficulty of doing this, even when working to so low a sulphur content as 0·006 grain per cubic foot, was overcome by means of a new recording device. Continuous tests of the sulphur activity in various parts of London since April 1, 1936, prove that the starting of the Fulham Power Station on November 1, 1936, has had no apparent effect on the atmospheric pollution. The pollution varies with the season and with the weather, being large in winter and during cold winds. The two chimneys are built of reinforced concrete and rise 300 ft. above ground-level. The gas-washing plant runs on a non-effluent system which is similar to that devised concurrently by Imperial Chemical Industries, Ltd.

Science and Socialism

THE first of a "Social Science Series" of pamphlets edited by W. P. Dreaper is entitled "The Future of Civilisation and Social Science" (London: E. T. Heron and Co., Ltd. 1*s*.). In it Mr. Dreaper presents a study of the principles of scientific meliorism based on Jane Hume Clapperton's book published in 1885, in which socialism is defined as concerted aims for social ends, and scientific meliorism may be regarded as a form of socialism under which progress must come through the individual social unit and not by means of social veneer. Scientific meliorism discriminates between benevolence which is beneficial and that which is not, giving no support to charities which injure the independence of the poor, or relieve them of parental responsibility. It opposes the social forces of sympathetic selection which result in the survival of the unfit and seeks to promote intelligent selection which would result in the birth of the fit. It strenuously supports co-operation in industry as a means of progress and harmony of interests, and proper distribution as a means of improving human conditions. Scientific meliorism also advocates a rational treatment of crime, in which vindictiveness has no ultimate place, and calls for a similar rational attitude to such questions as manners, dress, the equality and relations of the sexes, marriage laws, laws of inheritance, etc., the regulation of population in relation to the natural and industrial position of a nation, and Mr. Dreaper briefly discusses the bearing of its principles on the study of international problems.

Developments in Storage Batteries

DURING last year, there has been a widespread increase in the number and the variety of the applications of batteries for stand-by purposes and emergency lighting. In the annual review number of the *Electrician* of January 28, Mr. E. C. McKinnon points out that this is partly due to air-raid precautions, which naturally trust to storage batteries for emergency lighting. Manufacturers are using the popular sizes of the starting batteries used in motor-cars for this purpose when circumstances permit. In other cases, alkaline batteries or sealed-in lead-acid accumulators are employed. The vast programme for broadcasting and recording the incidents of the Coronation ceremony and processions was largely dependent upon batteries. Car radio equipment has been applied to police patrol cars and to police patrol pedal-cycles. Many systems of battery-controlled fire alarms have also been installed. There has been a considerable increase in the demand for accumulators for deaf-aid equipment.

VERY small batteries have been developed for use in meteorological balloons. These are made up into low-tension cells weighing 1 oz. each, and 60 cell (144 volts) high-tension batteries weighing only 9 oz. when complete with electrolyte. There has been a great demand for batteries for auxiliary propulsion of trolley buses. This system is most useful for manœuvring the vehicles at termini or at special points such as football grounds or on the route lines in the event of power supply failure. There has been an increase in the number of electric vehicles in operation last year of 31 per cent. Bakeries, dairies and salvage departments are using large fleets of electric vehicles. Fleets of 100 to 150 electric vehicles are now not uncommon. Air conditioning by the aid of storage batteries has made great progress in India, but the need for it in Great Britain is not large at present. There have been more than a hundred patents in connexion with accumulators applied for last year, but none of them proposes any radical change in design. Special batteries are much used in aeroplanes and submarines. The standardization of accumulators is receiving attention both in Great Britain and internationally.

Journal of Marine Research

DURING the past several years there has been increasing interest in oceanographic research in the United States, which led to the foundation of the Woods Hole Oceanographic Institute and a special department of the University of Washington, both with well-equipped vessels. From these, and the already established laboratories, there has come very real contributions to our knowledge of the oceans—the nature and causes of the current systems on one hand, and, on the other, studies in the varying productivity of the waters in plant and animal life. It is gratifying that Great Britain is now engaging in active co-operation with the Woods Hole Institute in a survey of the fluctuations from year to year in the current system of the north-west Atlantic, for which the Royal Society is now fitting out a vessel. The annual crop of scientific papers dealing with oceanography has grown rapidly. American contributions appear in rather many and diverse journals, both American and European, so the birth in November last of the *Journal of Marine Research* comes at a time when its growth is likely to be rapid. It is published by the Sears Foundation, Oceanographic Laboratory of Yale University, and its scope includes articles on physical meteorological theory, owing to

the "intimate connection between hydrospheric and atmospheric events in nature, and to the virtual identity of dynamic methods and theory in Meteorology and Oceanography". The six contributions appearing in the first number are equally divided between physical and biological subjects, and include an article on evaporation from the oceans by H. U. Sverdrup, now director of the Scripps Institute, on seasonal variations in the water of San Juan Channel, and on a survey off the mouth of the Mississippi, showing effects of river water and the distribution of phytoplankton.

Medical Milestones

UNDER this heading, the *Medical Record* of New York for January 5 mentions the following notable events in the history of medicine which occurred in the course of 1838: foundation of the University of Messina, which later developed a remarkable medical curriculum, and of the Medical College of Richmond, Virginia; publication by Malgaigne of his treatise on experimental surgery and by Johannes Müller of his treatise on tumours; the first accurate description of pulmonary tuberculosis by Corrigan; performance by Mettauer of the first operation for vesico-vaginal fistula; description by Southwood Smith of conditions, especially fevers, among the poor in London in his reports to Parliament, and the foundation of the Royal Orthopædic Hospital of London.

Anti-Rabic Treatment in Southern India

THE director, Major Iyengar, in his annual report for 1936 of the work of the Pasteur Institute of Southern India, Coonoor, states that 493 patients underwent a full course of treatment, an increase of 60 compared with the previous year. For the fourth time during the thirty years of its existence, no deaths occurred from hydrophobia among those treated at the Institute. In addition to the treatment at the Institute, 15,302 courses of anti-rabic vaccine were issued for use at out-centres. Semple's carbolized sheep vaccine was in use, prepared from Paris fixed virus, which was in its 978th passage at the close of the year. In addition to human beings, 659 animals also received anti-rabic treatment during the year.

The Day Lily

MEMBERS of the genus *Hemerocallis* enjoy an increasing popularity as garden plants. The name signifies 'beauty for a day', and is a reliable description for individual flowers. The plant, however, maintains a succession of bloom, and is tolerant of a wide variety of cultural conditions. Mr. G. P. Baker has prepared a short monograph of the genus (*J. Roy. Hort. Soc.*, 62, 9, 399–411, Sept. 1937). A historical summary traces the early references to *Hemerocallis flava* from the time of Dioscorides, whilst the modern uses of the plant as medicine and as a flavouring in China, are set forth. Detailed descriptions of fourteen species and their variants impart much knowledge for the gardener.

Société des Amis de Paul Painlevé

THE late Paul Painlevé made a place for himself in contemporary history not only as a great mathematician but also as a statesman of conspicuous ability. A collection of his essays and speeches are gathered together in book form (price 20 francs), and published by the "Société des Amis de Paul Painlevé", which has for its aims the cultivation of his memory and of his scientific and democratic ideals, and eventually the publication of his papers. This association has issued an appeal to all the friends of Painlevé throughout the world, and will particularly welcome adherents from Great Britain (minimum subscription, 1*s.* 6*d.* a year). The chairman of this organization is M. Pierre Appell (3 rue du Vieux Colombier, Paris), who was one of the closest collaborators of the great French statesman.

Medical Men in Austria

WE have received the following communication from the Medical Peace Mission, 12 Kent Terrace, Park Road, London, N.W.1, signed by eighteen distinguished British medical men: "In view of recent events, we desire to express our alarm at the possible fate of our colleagues in Austria. There are in that country many revered physicians and surgeons who are likely to fall into disfavour with the National Socialist Government either on account of their medical or social views or on account of their belonging to the Jewish race. Judging from what has happened in Germany in the past, we are afraid that serious discrimination will be exercised against them and that even the chance to leave a country which is no longer hospitable to them may be refused. We beg our colleagues in all countries to watch the progress of events with the closest attention and to do all in their power, whether by public protest or by public or private assistance, to stand by any members of our profession who may suffer hardship under the new régime."

The Night Sky in April

Full moon occurs on April 14 at $18{\cdot}3^h$ and new moon on April 30 at $5{\cdot}5^h$ U.T. No stars brighter than mag. 6·1 are occulted during the month; for particulars of the seven occultations visible from Greenwich, see page 526 of the "Nautical Almanac". Lunar conjunctions with the planets occur as follows: on April $1^d\ 23^h$ with Venus: April $2^d\ 6^h$ with Mercury: April $3^d\ 8^h$ with Mars: April $25^d\ 2^h$ with Jupiter and April $28^d\ 11^h$ with Saturn. On April $8^d\ 16^h$, Mercury and Venus are in conjunction, and on April $15^d\ 20^h$ Venus and Uranus, Venus being only 0·1° north of Uranus (geocentric positions). Venus and Mars are both evening stars; Mercury is an evening star until April 21, and at greatest eastern elongation on April 2. On April 1 at about 19^h, the moon's slender crescent and the planet Venus will be nearly at the same altitude low in the western sky. In mid-April at 22^h, Orion will have nearly set in the west, but Procyon, Castor and Pollux still remain. Capella in the north-west balances Vega in the north-east. The

bright star Arcturus, the spectrum of which closely resembles that of sunspots, is conspicuous east of the meridian. Arcturus has the notable proper motion of 2·3″ per annum. In its train, there is the small, beautiful constellation of Corona Borealis. On or about April 21, the Lyrid meteors may be looked for, their radiant point being at R.A. $18^h\ 4^m$ and Dec. 33° N. It should be noted that Summer Time in the British Isles commences on Sunday, April 10, at 2^h.

Announcements

PROF. F. G. DONNAN has been elected an honorary member of the Verein Österreichischer Chemiker.

SIR ROBERT HADFIELD has been awarded the Trasenster Medal and Diploma for 1938 by the Association des Ingénieurs de Liège. This award has previously been given to M. Henry Le Chatelier, the well-known French man of science, the Marchese Marconi, M. Edouard Branly, the distinguished physicist and one of the pioneers of wireless, M. Georges Claude, inventor of the processes known under his name for the liquefaction of air and for the fixation of atmospheric nitrogen, Mr. Waldemar Lindgren, American geologist, and M. André Blondel, distinguished for his researches in electricity and illumination.

THE London Midland and Scottish Railway has appointed Dr. W. A. Macfarlane to be senior research chemist. Dr. Macfarlane was educated at Westminster School and Balliol College, Oxford; he took a first in chemistry in 1930, and was awarded a B.Sc. for his research work in physical chemistry. He acted as demonstrator in natural science at Balliol from 1930 until 1932, and was then elected a Commonwealth Fund fellow at the University of California, where he carried out research in spectroscopy. Since 1934 he has been a scientific officer at the Fuel Research Station, where he specialized on the production of synthetic oils, and later acted as personal assistant to the Director of Fuel Research.

MR. F. H. Wynne, deputy chief inspector of mines, has been appointed chief inspector of mines in succession to Sir Henry Walker. Sir Henry Walker, who entered the Mines Inspectorate in 1902 and has been chief inspector for nearly fourteen years, retired on March 17 on reaching the age limit.

THE sixth of a series of public lectures on "Science in the Social World", which has been organized by the Left Book Club Scientists' Group, will be held on March 28, at 8 p.m. at the Conway Hall, Red Lion Square, W.C.1, when Prof. P. M. S. Blackett will speak on "The Social Background of the Rise of Science in the Seventeenth Century".

DR. H. H. VÖLCKERS, Plenipotentiary Minister of the German Reich at Havana, has been elected an honorary member of the Cuban Society of Biology, and Dr. Hans Böker, professor of anatomy at Jena, an honorary member of the Cuban Society of Natural History.

DR. FRIEDRICH BERGIUS has been made an honorary member of the Physical Association at Frankfort, and Dr. Eduard Richters, senior veterinarian in the Army Veterinary Investigation Department, a member of the Imperial Leopold Caroline German Academy at Halle.

AN anti-alcohol museum at Warsaw has recently been opened by the Polish Minister of Social Welfare.

THE eighth International Congress of Thalassotherapy will be held at Montpellier on June 3–5 under the presidency of Dr. A. Aimes, when papers will be read on the meteorological factors of sea climate. Further information can be obtained from the general secretary, 8 rue André-Michel, Montpellier.

The annual Conference of the Museums Association will be held in Belfast on July 4–9, under the presidency of Dr. R. E. Mortimer Wheeler. Further information can be obtained from the Secretary, Museums Association, Chaucer House, Malet Place, London, W.C.1.

THE Chicago Tumor Institute, which is a non-profit-making corporation at 21 West Elm Street, Chicago, was opened on Monday last, March 21. The scientific committee consists of Dr. Max Cutler (director), Sir G. Lenthal Cheatle, Dr. Henri Coutard, Dr. Arthur H. Compton and Dr. Ludvig Hektoen. The Institute will offer consultation service to physicians in the diagnosis and treatment of cancer and radiation facilities for cancer patients. It is also proposed to conduct research at the Institute and to offer training to physicians who may wish to qualify as specialists in the study and treatment of this disease.

THE Cambridge University Press announces two developments in its policy of providing the increasing number of readers not engaged in science, but interested in the advance of knowledge, with informative books by men who are authorities in their own subjects. The first is Einstein's own account of his great discovery of relativity, "The Evolution of Physics", by himself and Dr. L. Infeld, which on March 28 will inaugurate a new series, "The Cambridge Library of Modern Science". Later in the same week will come the first number of a new series of *Discovery*, the popular scientific monthly, which has been taken over by the Cambridge University Press and will provide the general reader with a regular link with the latest discoveries and developments in all branches of knowledge. Dr. C. P. Snow, of Christ's College, is the new editor of *Discovery* and also general editor of "The Cambridge Library of Modern Science".

ERRATUM. In NATURE of March 12, p. 471, letter by Dr. P. Suomalainen entitled "Magnesium and Calcium Content of Hedgehog Serum during Hibernation", par. 4, line 6, for "Kursiv" read "*Helix*".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 559.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Rate of an Atomic Clock in Motion

ACCORDING to the theory of the relation between matter and the luminiferous ether, as developed by Larmor and Lorentz, a moving clock should assume the rate

$$\nu = \nu_0 \sqrt{1 - \frac{V^2}{c^2}},$$

where ν_0 is the stationary rate, V the measured velocity of the clock with respect to the observer, and c the velocity of light.

It was pointed out by Einstein in 1907 that the newly discovered Doppler effect in canal rays offered a means for making a test of this prediction. This experimental test, the crucial nature of which has been emphasized repeatedly in the last thirty years (under the designation of the 'transverse Doppler effect') has not heretofore been performed. It has been commonly considered as beyond experimental practicability, chiefly on the ground that as the moving canal rays are not homogeneous in velocity, the 'displaced' line is too diffuse for sufficiently exact measurement.

This objection has recently been removed, due to the development, by Dempster, of a design of canal ray tube which gives displaced lines of a sharpness comparable with the undisplaced. In this form of tube, the positive ions produced behind the electrode are accelerated between two slightly separated pierced plates between which a high potential difference exists.

Recently, with the assistance of Mr. G. R. Stilwell, I have made an experimental test of the Larmor-Lorentz prediction, using canal ray tubes of the Dempster type. The hydrogen line 4861 A. has been used, observations being made by means of a plane grating of metal on glass of 15,000 lines to the inch, made by Prof. R. W. Wood, which, in conjunction with two 5-in. diameter, 5-ft. focus telescope objectives, formed a sufficiently powerful spectrograph for the purpose. By means of a small concave mirror mounted on the pierced electrodes, end-on observation gave, on one plate, the displaced lines due to motion toward and away from the spectrograph slit. The apparatus was arranged to turn in any desired direction in the horizontal plane.

For the voltages used, which were about 18,000, the displaced H_β lines, which were the most feasible for study, should, according to the theory, have their common centre of gravity displaced, with respect to the undisplaced line, by approximately 0·05 A. towards the red, which is readily detectable with the dispersion employed.

The result of the experiment was to show a displacement in the predicted direction, independent of the orientation of the apparatus, and agreeing, within the errors of measurement, with the value indicated by theory.

The importance of this experiment lies in the fact that it yields a positive effect, as distinct from the null effects obtained in other optical experiments, which latter might be explained by an entrained ether. It is therefore decisive in favour of the Larmor-Lorentz theory.

A full account of the experiment will be published shortly.

HERBERT E. IVES.

Bell Telephone Laboratories,
New York, N.Y.
Jan. 27.

Effect of Solvents on the Absorption Spectrum of Vitamin A

IT has long been known that some substances, for example, indigo, yield variously coloured solutions in different solvents. Change of solvent may affect the intensity and position of absorption maxima in the ultra-violet as well as in the visible spectrum. The fact that this phenomenon has been observed with a related substance, carotene, makes it the stranger that various solvents are commonly accepted as interchangeable for the spectrophotometric assay of vitamin A. Thus ethyl alcohol and cyclohexane received equal sanction at the 1934 International Vitamin Conference and in the 1936 "Addendum to the British Pharmacopœia"; ether is also used in some laboratories, but chlorinated solvents, particularly chloroform, have been regarded with suspicion.

We now find that the vitamin A absorption bands of fish-liver oils and concentrates may vary somewhat with change of solvent, both in position and in magnitude. The values of $E^{1\%}_{1cm.}$ 328 mμ, for three oils and two concentrates, in five solvents are summarized in the accompanying table. For ease of comparison, the values in solvents other than alcohol are expressed as percentages of the absorption in alcohol. Each figure represents the mean of two to four highly concordant independent determinations. Consistently higher results were obtained with alcohol than with cyclohexane or hexane as solvent, and we believe that the differences have real significance.

Substance	$E^{1\%}_{1cm.}$ 328 mμ in alcohol	Absorption at 328 mμ relative to 100 for alcohol				
		Alcohol	Cyclo-hexane	Hexane	Ether	Chloro-form
Halibut-liver oil 12/136	40·8	100	99	102	110	93
Halibut-liver oil 12/214	30·1	100			116·5	93·5*
Fish-liver oil 11/323	52·7	100	97	95	99·5	85·5
Concentrate 12/099	630	100	99	96·5	105	86·5
Concentrate 12/168	480	100	95·5	97	106	86
Average		100	97·5	97·5	107·5	89

* One determination only.

The high results in ether (4 samples out of 5) and the even more markedly low results in chloroform certainly differ from those in alcohol by amounts well outside the limits of experimental error. Chloroform also caused a shift in the position of the maximum to approximately 333 mμ; the other solvents caused no shift detectable with certainty, except that with cyclohexane the maximum appeared to be nearer 330 mμ than 328 mμ. Morton[1] found that chloroform gave low results, but attributed the phenomenon to instability of vitamin A in this solvent. Although vitamin A certainly is unstable in chloroform, this is not sufficient to explain our findings. A chloroform solution of halibut-liver oil gave a value $E^{1\%}_{1cm.}$ 328 mμ = 26·4; the chloroform was evaporated from this solution under reduced pressure and replaced by an equal volume of ether; this ether solution gave $E^{1\%}_{1cm.}$ 328 mμ = 31·7; a direct solution in ether gave $E^{1\%}_{1cm.}$ 328 mμ = 31·8.

The materials listed in the table fall into two groups, comprising on one hand the first two oils, and on the other the third oil and the two concentrates. Relative in each instance to the absorption in alcohol, the first group shows greater enhancement of the absorption in ether and less depression in chloroform than does the second group. These irregularities are probably due to differences in the proportion of *cis-trans* isomers of vitamin A. These isomers may not only have different absorption coefficients in any one solvent, but also the ratio of these coefficients may vary from solvent to solvent. Possible differences between the biological activities of the isomers may help to explain the various factors reported relating $E^{1\%}_{1cm.}$ 328 mμ to biological units.

We have further observed that irradiation of solutions of vitamin A sometimes increased and sometimes decreased (by so much as 40 per cent) the absorption at 328 mμ, but that the absorption almost returned to the original value after the irradiated solution had stood in the dark. Variations in the proportion of *cis-trans* isomers might explain these results and also some of the spontaneous increases as well as decreases in absorption of liver oils and concentrates during periods of storage which have been observed by ourselves and others (*cf.* Heilbron, Gillam and Morton[2]; *cf.* also the experiences of Holmes and Corbet[3] with crystalline vitamin A and of Zechmeister and Tuzson[4] with lycopene).

It is intended to publish full details elsewhere of the work summarized here and additional work now in hand.

Note added to proof. Since submitting this letter for publication we have learned that Dr. A. E. Gillam and Dr. M. S. El Ridi have—independently of ourselves—studied the effect of solvents on the vitamin A absorption spectrum.

E. LESTER SMITH.
BABETTE E. STERN
F. E. YOUNG.

Technical Research Laboratory,
Glaxo Laboratories, Ltd.,
Greenford, Middlesex.
Feb. 21.

[1] Morton, private communication.
[2] Heilbron, Gillam and Morton, *Biochem. J.*, **25**, 1352 (1931).
[3] Holmes and Corbet, *J. Amer. Chem. Soc.*, **59**, 2042 (1937).
[4] Zechmeister and Tuzson, NATURE, **141**, 249 (1938).

THE above authors have been good enough to show me their letter. The 1934 Conference was concerned with a substitute for the bio-assay with its experimental error of perhaps ± 25 per cent for individual assays. The fact that variations of a few per cent for spectrophometric assays in different solvents like alcohol and cyclohexane are now being noted is an indication of the progress made. Such variations are usual for polar molecules and do not invalidate the spectrophotometric method.

The possibility of variable proportions of geometrical isomerides in different vitamin A containing materials has been obvious since the polyene formula was established. So many isomerides are theoretically possible with five ethenoid linkages (four in a straight chain) that the problem of their occurrence has long defied experimental attack, and it has been reasonable to assume a balancing of effects.

With one double bond as in *cis* and *trans* stilbene and cinnamic acid[1], differences in ε max. are of the order 2 : 1, an effect much larger than that observed except in the valuable irradiation experiment.

I have approached the problem from another angle. Hitherto the ultra-violet absorption (328 mμ) and the $SbCl_3$ colour test maximum (620 mμ) have shown a nearly constant ratio $E^{1\%}_{1cm.}$ 328 mμ/620 mμ of 0·32 for rich preparations. A halibut intestinal oil prepared by Dr. Lovern has been subjected to molecular distillation by the courtesy of Dr. F. H. Carr of Messrs. British Drug Houses, Ltd. In the different fractions the ratio varies from 0·21 to 0·38 and for a range of very rich ester fractions it is *c.* 0·28. A partial separation of *cis-trans* isomerides is a plausible explanation.

R. A. MORTON.

The University,
Liverpool.

[1] Smakula and Wassermann, *Z. phys. Chem.*, A, **155**, 353 (1931).

Specificity of Disaccharide-splitting Enzymes

DISAGREEMENT exists concerning the substrates which maltases of different sources can hydrolyze. According to the view advanced by Leibowitz[1], there occur in Nature two types of maltase, a gluco-maltase and a glucosido-maltase respectively. The gluco-maltase which occurs in malt and in moulds splits maltose but is inert towards alpha-glucosides and sucrose; the glucosido-maltase which occurs in yeast splits alpha-glucosides as well as maltose. Different investigators[2] have applied the two maltase classification over a wide range of maltases from various sources. Weidenhagen[3], however, has denied the validity of this view, and claims that in sufficient enzyme concentrations, even malt and taka-diastase hydrolyze alpha-methyl-glucoside. All maltases in Nature are said therefore to be glucosido-maltases; they are considered to be identical with the gluco-sucrase among the sucrases, and to split alpha-glucosides and sucrose as well as maltose.

In the course of a series of tests on the heat stability of different lots of taka-diastase, taka-maltase preparations were found which were peculiarly resistant to inactivation by heat. This property has enabled us to make additional observations on the question of the specificity of taka-maltase. If a solution of the enzyme is heated to boiling point, these resistant preparations lose their ability to split sucrose and also what slight activity they formerly possessed to

split alpha-methyl-glucoside; they retain, however, or regenerate after the heating, most of their ability to split maltose.

It follows, therefore, that the inversion of sucrose by taka-diastase is not even partially due to taka-maltase but to a distinct taka-sucrase. It seems reasonable also to believe with Pringsheim that the slight alpha-glucosidase action observed by Weidenhagen in concentrated taka-diastase preparations was due to the admixture with the predominant gluco-maltase in mould of a small quantity of glucosido-maltase.

A further proof that yeast maltase and taka-maltase are different was furnished by a study of the effect of taka-diastase on yeast maltase solution. Yeast maltase solution incubated for a definite time interval with a sufficient concentration of taka-diastase loses completely its ability to hydrolyze either alpha-methyl-glucoside or maltose. The ability of the taka-maltase to split maltose is not, however, removed under these conditions. Taka-diastase thus contains an inhibitor for yeast glucosido-maltase. The inhibitor is heat labile, non-dialyzable and distinct from taka-maltase.

The nature of the 'heat-stable' taka-maltase, the manner of inhibition of the yeast maltase, and in particular the effect of the inhibitor in taka-diastase upon maltose fermentation by zymase will be reported in detail elsewhere.

J. LEIBOWITZ.
S. HESTRIN.

Department of Hygiene and Bacteriology,
The Hebrew University,
Jerusalem.
Feb. 6.

[1] Leibowitz, J., *Z. physiol. Chem.*, **149**, 184 (1925); Leibowitz and Mechlinsky, *ibid.*, **154**, 64 (1926).

[2] See, for example, Pringsheim, Borchardt and Loew, *Z. physiol. Chem.*, **202**, 23 (1931); Pringsheim and Loew, *ibid.*, **207**, 241 (1932); Karstroem, H., *Biochem. Z.*, **231**, 399 (1931); Tauber and Kleiner, *J. Gen. Physiol.*, **16**, 767 (1932-33); *J. Biol. Chem.*, **105**, 679 (1934).

[3] Weidenhagen, R., "Ergebnisse der Enzymforschung", Vol. 1 (1932); *Z. physiol. Chem.*, **216**, 255 (1933), and elsewhere.

Action of Molybdenum in Nutrition of Milking Cattle

A LARGE area under pasture in Somerset cannot be grazed by cows during the normal grazing season (April–October) without milk yields falling rapidly, causing marked loss of condition and even death. The disorder, which has been known for very many years, is marked by extreme diarrhœa; other cattle and sheep also scour on such herbage, though the loss of condition is not so obvious as with the milking animal. Such fields are described as being 'teart'. The area involved is estimated at about 20,000 acres by Gimingham[1], and the annual loss to the farming community must be very great. The available information seems to rule out bacteria, parasites, water supply or a particular herb as causal agents, and points to the presence of some constituent of the soil taken up by the herbage[2].

Spectrographic examination of a few samples kindly supplied to us by Mr. A. W. Ling and Mr. W. R. Muir of the University of Bristol showed the presence of molybdenum in 'teart' herbage. A more extensive and systematic examination which we have since conducted on 'teart' and 'non-teart' fields in Somerset has confirmed the fact that the molybdenum content of 'teart' herbage is considerably higher than that of the 'non-teart' fields situated close by.

There is no apparent correlation between the total or HCl-soluble molybdenum of the soil and that of the herbage. Comparisons are, however, complicated by the fact that 'teart' and 'non-teart' fields are managed in such a way that the herbage is at different stages of growth at any one time of the year.

We have fed soluble molybdates in quantities equivalent to those provided in an average daily ration of really 'teart' herbage (1·36 gm. Mo per head per day) to five dry cows at Jealott's Hill, and in three cases have produced extreme scouring and loss of condition similar to that which occurs in 'teart' fields in Somerset. Whether the molybdenum is directly responsible or whether it catalyses a toxic product in the rumen we do not yet know. It is generally stated in the 'teart' areas that horses are not affected, but it is impossible to say at present if this is due to the simple stomach or to differences in grazing habit.

The investigation is still being pursued. Our thanks are due to Mr. Milbourn of I.C.I. (Metals), Ltd., for the spectrographic examination of the early samples from Bristol.

W. S. FERGUSON.
A. H. LEWIS.
S. J. WATSON.

Jealott's Hill Research Station,
Bracknell,
Berks.
Feb. 22.

[1] Gimingham, C. T., *J. Board Agric.*, **17**, 529 (1910).
[2] Muir, W. R., *Agric. Progress*, **13**, 53 (1936).

Potential Changes in the Ears of Reptiles and Fish

Wever and Bray's work has shown that in mammals the cochlea behaves like a microphone, giving electric oscillations which are an accurate transcription of the sound waves. The most plausible explanation of the effect is that of Hallpike and Rawdon Smith, namely, that it is due to the vibration of a polarized membrane separating endolymph and perilymph, but other hypotheses have been put forward.

The object of this communication is to direct attention to the similar effect in the inner ears of cold-blooded vertebrates. In alligators there is a cochlea, and it is not surprising to find potential changes, as in mammals, copying the sound waves. In lizards the potentials which can be detected in the inner ear are of the same form, but are much smaller. In tortoises they are often too small to be distinguishable from artefacts due to electrode movement. In the eel, however, the inner ear structures are more accessible and large potential oscillations can be recorded from the saccule when the head is exposed to vibration. The saccular response in the pike, described by Piper (1910)[1], is presumably due to the same cause. The frequency of the potential changes which can be induced in the inner ear seems to be limited merely by the frequency at which the structures can be made to vibrate; the maximum frequency of response in the fibres of the auditory nerve is much lower, since there must be time for recovery after each impulse.

E. D. ADRIAN.

Physiological Laboratory,
Cambridge.
March 7.

Piper, H., *Arch. Anat. u. Physiol.*, Physiol. Supp., 1, 1910 (1910).

Activity and Insect Survival

WHILE laboratory experiments have revealed new facts of insect biology, some have given results which have been interpreted in such a way as to cause confusion. Experiments measuring longevity have often given ambiguous results. At present, much work is being done on the survival of the bed-bug, *Cimex lectularius*, and as this insect is a domestic pest usually found in confined spaces, it appears at first sight admirable for laboratory study. Imprisonment among paper in a tube differs little from the conditions of the normal environment. Yet the times of survival found by various investigators[1,2,3] working under similar climatic conditions are so different that it is, for example, quite impossible to say how long bugs must be left in an unoccupied house with no sources of food before they will all die from starvation.

Recent experiments throw some light on the subject. When newly emerged, unfed and unfertilized females of *Cimex lectularius* were starved, singly, in 3 in. × ½ in. glass tubes at 30° C. (86° F.) and 25 per cent relative humidity, in darkness except when examined, they survived on an average 134 days (limits 116 and 145 days, standard deviation 9·1). The insects seldom moved more than a few millimetres. Now if similar bugs after only one week's starvation were put on an open and well-illuminated surface, they would run about rapidly. If they were kept running for several minutes, and then allowed to feed, they survived; but if they were *not* fed, they died in a few hours. The extra activity due to running for several minutes was apparently sufficient to exhaust reserves which would have kept a resting bug alive for several months. In the longevity experiments mentioned above, I took particular care not to disturb the insects when examining them, and thus obtained a length of life far longer than that previously found by other workers under similar climatic conditions.

It is not unlikely that by using suitable methods we shall find that at temperatures comparable with those occurring naturally in Great Britain, bugs will be able to survive for years. The variability of previous workers' results appears to depend on the extent to which their technique disturbed the insects; in the field, conditions which affect activity will affect longevity, not only with *Cimex* but also with other species. Experiments must be planned to make allowances for this important factor. In the case of the bed-bug we must discover what internal and external stimuli cause activity and hunting for food, and how often unsuccessful individuals die from exhaustion.

KENNETH MELLANBY.

Sorby Research Laboratory,
University, Sheffield.
Feb. 22.

[1] Geisthardt, G., *Z. Parasitenkde.*, **9**, 151 (1937).
[2] Johnson, C. G., *Proc. Zool. Soc. Lond.*, A, **107** (1937).
[3] Kemper, H., *Z. Morph. u. Ökol.*, **19**, 160 (1930).

Occurrence of young *Ophiothrix fragilis* within the Genital Bursa of the Adult

IT has been recorded by Mortensen[1,2,3] that young specimens of the ophiuroids *Ophiothrix fragilis* Abildgaard, *O. triglochis* M. and Tr. and *Ophiactis Krøyeri* Ltk. are sometimes to be found clinging to the arm spines of the adults. The occurrence of the young individuals on the adults does not, in Mortensen's opinion, indicate a viviparous habit in these ophiuroids since one, at least, namely *O. fragilis*, is known to have pelagic larvæ; rather, it is "quite by chance that the young ones, after their metamorphosis from the pelagic larvæ, happen to settle down on adult specimens in places where these latter occur in good numbers"[2].

In view of this 'accidental' appearance of the young ophiuroids on the arm spines of the adult, it would be unwise to assume that their presence, even within the adult genital bursa, was, in itself, an indication of a viviparous habit. Fedotov[4], who found a specimen of *Gorgonocephalus eucnemis* M. and Tr. with a young individual in the depth of the bursa was inclined to regard *Gorgonocephalus* as viviparous, although he considered the question, on such evidence, as not being entirely solved.

While working at the Plymouth Marine Biological Laboratory in December last, I examined some two hundred specimens of *O. fragilis* and found that about 10 per cent of that number had young *Ophiothrix*, of a disk diameter of 0·25–0·5 mm., clinging to the spines and tube feet of the oral side of the arms. The number present on a single individual varied from one to fifteen. In five of these individuals, however, much larger specimens (of about 2 mm. disk diameter) were found *within the bursa*, one in each adult. The presence of young brittle-stars within the bursa of an oviparous species demonstrates conclusively that their presence does not necessarily indicate viviparity.

In the case of *O. fragilis*, the young post-metamorphic stages find shelter among the spines of the older individuals, from which they can only be dislodged with difficulty owing to their habit of wrapping round the spines and attaching themselves by means of their arm hooks. With increasing size, attachment becomes a matter of greater difficulty and it may be supposed that the larger specimens, in search of better shelter, occasionally move towards the openings of one of the bursæ and crawl inside, there to settle until they become too large to be housed in comfort. They would then leave the bursa and seek the shelter of a rocky crevice or stone as is the habit of the species.

On this assumption, the bursa would be regarded as a convenient habitation, rather than a nursery, for the post-metamorphic brittle-stars.

J. E. SMITH.

Zoology Department,
The University,
Sheffield, 10.
Jan. 27.

[1] *Acta Zoologica*, **1-2** (1920).
[2] *Vidensk. Meddel f. Dansk. naturhist.*, **93** (1932–33).
[3] *Danish Ingolf Exped.*, **4**, Nr. 8.
[4] *Trav. Soc. Nat. Petrograd*, **46** (1915).

Effects of Soft X-Rays upon Chætopods

THE effects of X-rays upon *Tubifex tubifex* and some other members of the class Chætopoda have been investigated by Stone, Turner, Zhinkin and others. They have reported, in general, that hard X-rays inhibited or destroyed the capability of regeneration, because it destroyed the neoblasts, although in appearance the general body tissue was little affected by their dosages.

It occurred to us to investigate the behaviour of *Tubifex tubifex* when irradiated with soft X-rays from a copper target X-ray tube operated at 30 kv. and 10 ma. The most intense part of the radiation had

a wave-length of 1·54 A., which, being less penetrating, might be expected to produce more drastic effects. The radiation was collimated by a narrow slit and allowed to strike selected somites of the animals placed 1 inch from the focal spot of the X-ray tube.

It was expected that the irradiated somites would be injured or killed, so that the animals would break into two parts, each of which would live just as though the animals had been cut into two parts with a scalpel. Actually it was found that irradiation of the first three to five somites resulted in the formation of protuberances of various sizes. These were either reabsorbed or the anterior section disintegrated. When the heart region was irradiated, no injuries were observed in a majority of the animals. Irradiation of the somites approximately in the middle of the animal caused it to break at the site of irradiation into two parts, but in more than 70 per cent of the cases the posterior section died, whereas had the animal been cut into two, both sections would have survived in almost every case.

The time of irradiation was 3 minutes in each set of irradiations. Histological studies are to be made of the injured sections, and further irradiation experiments are planned. We expect to publish a fuller treatment of the data at an early date.

H. KERSTEN.
H. BRANSON.

Department of Physics,
University of Cincinnati,
Cincinnati, Ohio.
Jan. 10.

Band Spectrum of Indium Hydride

IN connexion with investigations now in progress on some hydrides in the third group in the periodic system, I have studied the spectrum of indium hydride. The bands were obtained in the emission from an arc burning between electrodes of indium and carbon in hydrogen at high pressure, using the same conditions as in a previous investigation of the thallium hydride[1].

The spectrum of InH was photographed between 2200–8500 A. (dispersion 1·9 A./mm.). In the range between 5600–8500 A. several bands were observed, which probably belong to InH. Three of these bands with $\nu_0 = 16{,}904{\cdot}9$, 17,574·1 and 16,148·2 cm.$^{-1}$ were analysed.

The band, $\nu_0 = 16{,}904{\cdot}9$, consists of single P-, Q- and R-branches, corresponding to a $^1\Pi \rightarrow {}^1\Sigma$ transition. This band is degraded toward the violet, but at high J-values all three branches form 'secondary' heads. In the Q-branch all lines up to $J = 31$ are intense. $Q(32)$, however, does not appear, even if the pressure in the arc is increased to ten atmospheres, which indicates a pronounced predissociation. In the secondary head of the P-branch, above $P(20)$, the lines are too crowded to be distinguished, but the R-branch can be followed steadily up to $R(33)$. The intensity distribution in the R-branch is perfectly normal, and no sudden interruption of the branch can be observed. All this indicates a case of predissociation similar to that earlier known in the spectrum of MgH.

The two other bands with $\nu_0 = 17{,}574{\cdot}1$ and 16,148·2 consist of single P- and R-branches, degraded to the red, and correspond to a $^1\Sigma^* \rightarrow {}^1\Sigma$ system with (0,0) and (0,1) transitions, the lower state of (0,0) being identical with that of $^1\Pi \rightarrow {}^1\Sigma$. The following rotational constants have been calculated:

$^1\Sigma$, $B_0 = 4{\cdot}921$, $D_0 = 2{\cdot}24 \times 10^{-4}$.
$^1\Pi$, $B_0 = 5{\cdot}266$, $D_0 = 3{\cdot}28 \times 10^{-4}$.
$^1\Sigma^*$, $B_0 = 4{\cdot}883$, $D_0 = 3{\cdot}77 \times 10^{-4}$.

Besides these some bands appear in the red and infra-red. The more intense heads can be classified in the following two groups:

Band heads, degraded to the violet	Band heads, degraded to the red
16,906 cm.$^{-1}$	17,724 cm.$^{-1}$
16,828	16,788
16,163	16,467
	16,366
	15,981
	15,506
	14,227

The search for the still unknown spectrum of gallium hydride is now in progress.

Further details concerning the band spectrum of indium hydride will be published later.

BIRGER GRUNDSTRÖM.

Department of Physics,
University of Stockholm.
Feb. 21.

[1] Grundström, B., NATURE, 140, 365 (Aug. 28, 1937); Grundström, B., and Valberg, P., *Z. Phys.*, 108, 326 (1938).

Science and the Unobservable

IN his Royal Institution discourse, published in a Supplement to NATURE of January 1, Prof. H. Dingle has made an attempt to show that, if we regard the recent trend of physics (expressed by the principle: "nothing which is logically or physically unobservable is significant") as legitimate, we are idealists. This is no new conclusion and the very thing to which M. Maritain[1] and R. J. Dingle[2] object.

It seems that Prof. Dingle does not realize exactly for what reasons we can disagree with Einstein when he says that: "The concept [of simultaneity] does not exist for the physicist until he has the possibility of discovering whether or not it is fulfilled in an actual case. . . . As long as this requirement is not satisfied, I allow myself to be deceived as a physicist (and of course the same applies if I am not a physicist), when I imagine that I am able to attach a meaning to the statement of simultaneity".

When we speak as physicists, we consider only phenomena which are observable with physical means. When we speak as non-physicists, we consider, besides physical observation, also other means of apprehension. We can only pretend that the two ways of speaking are the same, if it is proved that we have no other means of apprehension than physical ones, that is, sense-perception. But if we do have such superior faculties, we cannot conclude that our limitations when we are using only a part of our faculties (physical means) are the same as when we are using all our faculties.

In the particular case considered here, the question therefore comes down to this: Can we, by means of our present human faculties, reach the idea of simultaneity without observing it physically?

In order to make it easier to answer this question, let us apply the above-mentioned principle (rejection of physically unobservables) to Prof. Dingle's article. What will be the result? By means of pure sense-

perception, we see black signs on white paper; we can measure these signs and investigate the physical properties of the materials. But if Prof. Dingle says that there is more than that in his paper, we will be obliged to reject this opinion because the reasoning which he wants us to understand is physically unobservable. This is our attitude as a pure physicist. But man has an intellect; he not only *knows*, he can also *understand*. He can have abstract ideas: 'the unobservable', 'truth', 'simultaneity', etc. In practice we cannot talk as 'pure' physicists. As human beings we always use our reason in addition to our sense-perception and we always reach to some extent the physically unobservable. It is for this reason that Prof. Dingle's article means more to us than paper and ink.

It seems clear that universal ideas, first notions on which all our reasoning is based and on which mathematics and science in general rest (axioms, postulates), are beyond sense-perception and physical observation. Our mind enables us to escape from the relative and reach the absolute.

Prof. Dingle's words: "M. Maritain and those who agree with him claim that the simultaneity of spatially separated events is something independent of our means of observing it. When asked what it is, they claim that its nature is immediately evident and that everyone knows it. But Einstein says he does not know it, and Einstein is an honourable man. And the only reply is that Einstein and his followers must be speaking as physicists" do not correctly state the question. Simultaneity is independent of *physical* observation, but not necessarily of the 'observation' of our minds. The abstract idea of simultaneity is immediately evident in the sense that we have (or should have) this evidence because we are rational beings. If Einstein believes that he has not this evidence, it may be because he did not consider sufficiently the question from this angle, or because he did not fully appreciate the power of mind[3].

In order to check idle invention, but to keep in mind our intellectual faculties, we need only replace the word "physically" by "essentially" in the above principle. Nothing which is logically or essentially unobservable is significant.

Prof. Dingle seems to be perfectly right when concluding that divergence of opinion results from a difference of philosophical attitude. One may say that physicists are not always sufficiently aware that they are sometimes talking as metaphysicists. As a physicist, Einstein may base a theory on the assumption that 300,000 km./sec. = infinity, but as a rational man he has no right to maintain this postulate, because our mind is not limited by the speed of light, a physical phenomenon.

S. VAN MIERLO.

9 Rue Pierre Bertin,
Versailles.
Jan. 14.

[1] "Reflexions sur l'Intelligence", pp. 202–261.

[2] "The Faith and Modern Science", pp. 40–56.

[3] Other men of science, like Prof. Max Planck, who have paid a good deal of attention to the philosophical side of such questions, are fully aware of having such evidence. See "Positivismus und Reale Aussenwelt" (Leipzig 1931) and "Religion und Naturwissenschaft" (Leipzig, 1937).

PROF. DINGLE arrives at a startling conclusion, namely, that if any physicist believes that "the universe exists independently of our experience of it" he must also "presume that he is omniscient" (p. 28). This conclusion is reached in the course of an examination of the current principle in physics that only observable quantities are significant. In his reasoning, however, I think that he makes the mistake of overlooking the admittedly limited and in large part tentative character of all scientific knowledge.

To avoid misunderstandings of this sort, I think that Prof. Dingle's statement of the principle of observability needs to be amplified a little, perhaps as follows: Only that which is practicably observable —that is, only that which would be observable if we were able to use known means of observation to the known limits of their possibilities—can form part of present scientific knowledge, and only that which may hereafter become physically observable in this sense is to be admitted into the science of the future. In this form the principle does not deny the existence of what is unobservable, but merely locates it outside the realm of scientific knowledge; and it does not imply the claim that the physicist can make, here and now, a *final* classification of ideas into observable and unobservable, which would indeed partake of omniscience. More sweeping statements can be found, to be sure, among the commentators on modern physical theories, whose eloquence seems sometimes to outstrip their scientific caution, but scarcely in the professional writings of the *creators* of the new theories.

To take the example cited by Prof. Dingle, it is a fact that absolute simultaneity is unobservable in terms of modern physics, since known laws furnish us with no means of detecting it. To many minds there seems to exist a strong presumption that it will always elude detection, but this presumption can never rise to a certainty; Einstein himself would admit the possibility that a signal travelling with infinite speed may some day be discovered, and that in a certain sense absolute simultaneity would then become an observable thing. When Einstein said, in the passage quoted by Prof. Dingle, that the term had "no meaning", he was referring, I think, to a meaning in terms of present-day experience, and he ought to have said so. It can scarcely be doubted that he would allow to the concept of absolute simultaneity a meaning in the same sense as there is a meaning to the depth of the rabbit-hole down which Alice fell; in this sense we can all follow M. Maritain in distinguishing the meaning of a concept from its use.

Most physicists undoubtedly believe in the existence of a real world different from their own experiences; they feel that this concept best fits the fact that the performances of physical apparatus are largely independent of their own volition. (If I did not believe this, I should have difficulty in believing in the existence of Prof. Dingle.) But they do not claim the ability to explore this external world *completely*; and they will not bother to consider whether things that are destined to remain permanently beyond observation exist or not. "Trivial" our knowledge of the world may be, as viewed from the point of view of some non-human being; but this possibility, apparently disturbing to Prof. Dingle, is surely not a professional cause of annoyance to the working physicist, and I do not think it should seriously disturb any of us. Human experience is the ultimate source of all scientific knowledge, and what lies entirely outside of human experience, and is therefore unobservable, is no concern of science.

Recognition of the limited scope of its generalizations and indifference to the unattainable seem to be

two of the most valuable traits of the modern scientific method as contrasted with the speculations of the medieval philosophers, and I think that these are features which might well be introduced in much larger measure into other realms of human thought.

E. H. KENNARD.

Cornell University,
Feb. 17.

MR. VAN MIERLO makes two assumptions, neither of which accords with fact—namely, (1) that physics is distinguished from other studies by the instruments employed; and (2) that reason is not an instrument employed by the physicist properly so-called. With regard to the second, I would point out that most of the things to which the physicist attaches significance (for example, the interiors of the earth and stars, the occurrence of unobserved eclipses, etc.) are not observed by the senses, but apprehended by reason. On the first point it is surely common knowledge that the distinguishing characteristic of physics (and that purely for convenience) is not its instruments but its subject-matter. The physiologist who uses a galvanometer does not thereupon become a physicist, and if a physicist used a stethoscope, or even logic, to attack a physical problem, his work would not on that account be refused publication by the Physical Society. The determination of the time of occurrence of a physical event is a physical problem, and if the times of occurrence of two events are identical, the events are simultaneous. If Mr. Van Mierlo could determine those times for two spatially separated events *by any means at all*, and get results which are independent of his velocity (such velocity being defined, of course, in terms consistent with the definitions of the times and distances of the events, or the process would be irrational), physicists would acknowledge the obligation to revise their theories accordingly.

Prof. Kennard wants to remain a realist, that is, to believe in a world existing independently of experience; to avoid the stigma of a profession of omniscence; and to approve the scientific rejection of absolute simultaneity. Notwithstanding his letter, I do not see how this is possible.

Let A be the world in question, and A' that part of it which we can now experience. Then, as a realist, Prof. Kennard must admit that there may be a part, A-A', which is not experienced. As a non-professor of omniscience he must further admit that when he has discovered A'', the portion of A-A' which the complete exercise of known means of observation would allow him to discover, there may still remain a portion, A-A'-A'', which is beyond his knowledge. Now, absolute simultaneity does not belong to A' or A''. Hence, either it belongs to A-A'-A'' or it does not exist. As a realist, Prof. Kennard must admit a significant distinction between these alternatives; and, as a non-professor of omniscience, he cannot decide between them. He can therefore make no pronouncement on the matter. But the principle of relativity says: "It is impossible to detect motion relative to the ether"; and this is equivalent to a denial of existence to absolute simultaneity. It therefore *does* make a pronouncement on the matter. Prof. Kennard must therefore reject it; or cease to be a realist; or profess omniscience.

It is not a mere matter of words. Relativity does not merely say that we cannot now detect absolute simultaneity; we knew that before the theory was put forward. That is simply a statement of the *problem* aroused by the Michelson-Morley and other experiments, but relativity professes to be a *solution* of that problem. It proceeds to organize the experience we have in a way which would be invalid if absolute simultaneity were unobservable merely from temporary lack of knowledge.

I think that Prof. Kennard's reluctance to accept this conclusion arises from a mistaken notion of what idealism (in the sense implied in this discussion) means. He introduces the question of volition, but that has nothing to do with the matter. Certainly our observations are largely independent of our volition, but the question is simply whether we are to assign significance to "existence" independently of observation, voluntary or otherwise. When Prof. Kennard made the experiment of looking at NATURE of January 1, he saw marks which his rational mind interpreted in terms of a hypothesis called Dingle. The performance of his eyes did not depend on his volition—the marks which he saw had nothing to do with what he would have liked to see—and he could not make rational sense of his experience without the hypothesis referred to, however much he might have preferred to ascribe it to an illusion produced directly by the devil. All that holds good whether he is an idealist or a realist. The question is simply whether scientific progress is best described by saying that we start with experience and grant existence only to that which is necessary to correlate such experience rationally, or that we start with a hypothetical world independent of experience and proceed to find out all that we can about it.

HERBERT DINGLE.

Imperial College of Science,
London, S.W.7.
March 8.

The Advancement of Science and Society

WE are glad to read the letter in NATURE of March 19, under the above heading, from Dr. F. R. Moulton, Permanent Secretary of the American Association for the Advancement of Science. It need scarcely be said that the invitation from that body to the British Association to co-operate in forming the nucleus of a wider organization for this great object is engaging our earnest attention, and has already been brought to the notice of the Council of the British Association. We look forward to meeting Dr. Moulton and some of his colleagues this summer, to discussing the project with them, and to having them with us at our meeting in Cambridge. It may be added in regard to the last clause in Dr. Moulton's letter concerning the "planning of the necessary machinery", that a scheme in rough outline has already been forwarded to him for informal comment, in the hope that it may prove possible, whether on the basis of that scheme or of some other, to lay practical proposals before the governing bodies of both Associations at an early date.

P. G. H. BOSWELL.
(General Treasurer).

British Association for the
Advancement of Science,
Burlington House,
London, W.1.
March 21.

F. T. BROOKS.

ALLAN FERGUSON.
(General Secretaries).

Dementia Nomenclatorica Americana

UNDER the above heading, I wrote to NATURE of November 16, 1935, expressing consternation at the ever-increasing hypertrophy in the nomenclature of the Foraminifera. I have continued to correspond with my friend Dr. H. E. Thalmann, and it may interest readers of NATURE to note that, in the last six years, more than two thousand papers have been published upon these Protozoa. These papers give us sixty new families and sub-families, two hundred new genera and sub-genera, and two thousand four hundred new species and varieties. This gives us two to three new genera per month, and two new species per day.

The brain reels and the senses gape at what might be an even partially complete synonymy to-day, and with what the systematists will be confronted in, say, *another* six years is not pleasant to contemplate.

Editors (and others) might do worse than establish a rule to the effect that henceforward no synonyms shall be allowed other than those immediately following d'Orbigny, and up to and including H. B. Brady and his contemporaries.

And—to adopt the terminal terminology of Acts of Parliament: "The Conchyliologie Systématique of Denys de Montfort is hereby repealed."

Since the above was written I have received from Java a paper upon "a second species of *Biplanispira*, etc." This starts a new group of specific names. May we hope before long to add to our nomenclature, *Monoplanulina*, *Hydroplanispira*, *Junkeria*, *Fokkerinoides*, *Handley-Paginella*, and *de Havillandia*? At any rate this would immortalize men who have left the impress of their names upon science, and convey more to posterity than the too-familiar collaborators, who for lack of early literature give us, in turn, *Smithia jonesii* and *Jonesia smithii* for slightly differing forms of *Truncatulina variabilis*—which is no longer *Truncatulina*, but has turned *Cibicides* in a single night.

EDWARD HERON-ALLEN.

British Museum (Natural History),
S.W.7.

'Convergent' Sunbeams

FROM observations made on three different occasions during past few summers, I can corroborate in every detail 'convergent' sunbeams reported by J. J. Hopfield[1]. Always in the late afternoon, the sun just having set behind the Jura and sending out 'fan-like' beams of alternating light and shade, there seemed to be issuing from the opposite horizon behind the Savoyard Mountains (Mont Blanc) similarly radiating beams. Though somewhat faint overhead, the continuous course of these bundles could be clearly traced between the eastern and western horizon.

Only recently a friend told me that flying over Mexican waters about a 1,[illegible]0 ft. up during the solar eclipse he found himself to be the centre of converging beams from the corona.

ARNOLD C. KLEBS.

Les Terrasses,
Nyon (Lake Geneva).

[1] NATURE, 141, 333 (1938).

THE striking phenomenon reported by Dr. J. J. Hopfield[1] is occasionally seen in Great Britain. I have witnessed two excellent examples, one on June 24, 1935[2], and another on September 12, 1936[3], at Hastings. Mr. W. L. Baxter has recorded a similar occurrence on March 17, 1934, at South Farnborough, Hants[4]. In two of the cases mentioned, the sun had set 20–25 minutes previously. The rays were pale rose or delicate pink in two of these records and orange-yellow in the remaining one, and were of considerable width. The rays extended completely across the sky from north-west to south-east on June 24, 1935, and from west to east on September 12, 1936, and convergence due to perspective was extremely well and strikingly seen. These rays are perhaps more likely to be observed in thundery weather when hard and well-defined cumulus clouds may be ranged low down on the horizon (or even below the horizon) so that protuberances on the cloud throw shadows much in the same way as is commonly seen when the sun is shining brightly behind well-defined cumuli during the daytime. In the latter case rays may be both projected upwards and radiating from the sun as a centre if the cloud is large and unbroken and with a hard summit, or projected downwards to the ground (a much commoner occurrence) if there are breaks or holes in the cloud sheets.

In connexion with the latter example it was an old idea that these rays meant coming rain, and an old saying, "The sun is getting up his back stays, and it is time to look out for bad weather" refers to this; also these rays gave rise to a saying that the "Sun is drawing water" and rain will soon follow.

A. E. MOON.

39 Clive Avenue,
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Hastings.

[1] NATURE, 141, 333 (1938).
[2] *Met. Mag.*, 70, 158 (1935).
[3] *Met. Mag.*, 71, 210 (1936).
[4] *Met. Mag.*, 69, 119 (1934).

THE necessary conditions for the phenomenon of convergent sunbeams are a slight haze spread evenly overhead, and a few small cumulus clouds on the eastern horizon. The best example that I have seen was at sea while travelling from Cape Town to Durban at Easter 1899. By good fortune, Mr. R. T. A. Innes, then secretary of the Cape Observatory, and others were on board, and there was opportunity for careful observation and comparison of notes.

There was a beautiful sunset; cloud shadows radiated from the sun, converging toward a point as far below the horizon as the sun was above it. As the sun set this point rose and the rays met at the eastern horizon. Long bands of pink and blue arched over our heads and over most of the sky like markings of a huge melon. One could have sworn that they were curved—obviously curved—but they were really straight and parallel. A drawing or photograph of any small portion of the sky would have shown straight lines. To the north, south or overhead they would have been parallel, to the east or west they would have been straight but converging. After the sun had set, the converging point rose and a solid-looking blue band touching it, rose too. This was the shadow of the earth, which may often be seen in the east after sunset.

If there is a cloud partly within the band, and partly illuminated by the sun, its height may be calculated. I remember discussing this with Mr. Innes

and I tried to perform the calculation, but I saw that refraction would have a considerable effect, and I did not see how to make a quantitative allowance for it. By a curious coincidence, I have just received a copy of a paper by Prof. H. Dember, of the University of Istanbul, which includes a diagram almost identical with one which I sketched in my pocket-book a couple of days ago after discussing the matter with a scientific friend who agreed that allowance must be made for refraction.

A. P. TROTTER.

Greystones,
Teffont, Salisbury.

A PHENOMENON similar to that described by Dr. John J. Hopfield was well seen by a colleague (Mr. H. F. Finch, then of Abinger Magnetic Observatory) and myself from the summit of Leith Hill, Surrey, in September 1926. My recollection is that the clouds casting the apparently converging shadows were a little to the east of the zenith, and the beams were no doubt brought into prominence by a slight dust haze.

The rarity of the phenomenon must be attributed to the rather precise nature of the conditions necessary; namely, a clear western sky with the sun on the point of setting and a broken line of low cloud lying approximately at right angles to the direction of the sun. The beams passing through the interstices, being practically horizontal, will then appear to converge on the eastern horizon by perspective.

W. M. WITCHELL.

Royal Observatory,
London, S.E.10.

Points from Foregoing Letters

BY means of an improved canal ray tube of Dempster type which gives sharp displaced lines, and with a diffraction grating of 15,000 lines to the inch, Dr. H. E. Ives has observed a displacement of hydrogen lines of approximately 0·05 A. towards the red, *independent of the orientation of the apparatus*. This positive effect confirms the Larmor and Lorentz theory of the relation between matter and the luminiferous ether, according to which a moving clock (in this case the hydrogen molecules emitting the light waves) has its rate decreased in the ratio $\nu = \nu_0 \sqrt{1 - V^2/c^2}$.

A table showing the effect of various solvents (alcohol, cyclo-hexane, hexane, ether, chloroform) on the intensity of absorption in the region 328 mμ by substances containing vitamin A (halibut and fish oils and concentrates) is given by E. L. Smith, B. E. Stern and F. E. Young. The variation is about 20 per cent in the various solvents; chloroform shows a shift in the maximum absorption to approximately 330 mμ. The effect of the solvents is not the same on all the oils investigated and this, as well as the effect of irradiation and storage upon the oils, is tentatively ascribed to the presence of *cis-trans* isomers of vitamin A.

Dr. R. A. Morton, commenting on the above, states that after molecular distillation of halibut intestinal oils, different fractions show a variation in the ratio of the ultra-violet absorption to the antimony chloride colour test maximum, and this also could be plausibly explained by a partial separation of the *cis-trans* forms.

According to Dr. J. Leibowitz and S. Hestrin, certain taka-diastase preparations lose their hydrolytic activity towards sucrose and their slight hydrolytic activity towards alpha-methyl-glucosides, but retain or regenerate most of their hydrolytic ability towards maltose when heated in boiling water. By incubation with taka-diastase, a complete inhibition of yeast maltase may be obtained. Hence yeast-maltase and taka-maltase, the authors conclude, are essentially different in character.

The deleterious effects which herbage grown on the so-called 'teart' areas of Somerset has on milking cattle is due, according to experiments by W. S. Ferguson, Dr. A. H. Lewis and Dr. S. J. Watson, to the presence of excess of molybdenum in the soil and in the herbage therefrom.

Prof. E. D. Adrian reports that, as in the case of the mammals, the cochlea in the ears of reptiles and fishes behaves like a microphone; sound waves give rise in them to electrical potential changes.

Activity in bed-bugs increases the metabolic rate and causes death in a fraction of the time in which resting bugs die. Dr. Kenneth Mellanby directs attention to the importance of considering activity as one of the principal factors in laboratory experiments made to study insect biology.

The occurrence of the young of the brittle star, *Ophiothrix fragilis*, in the genital bursa of the adult is, according to Dr. J. E. Smith, an accidental occurrence, and the bursa may be regarded as a convenient habitatjon rather than a nursery for the post-metamorphic stage.

According to H. Kersten and H. Branson, irradiation of the first three to five somites of a chætopod usually resulted in the formation of protuberances of various sizes. The heart region was much more resistant; the majority of the animals showed no ill-effects. Irradiation of the somites approximately in the middle of the animals generally resulted in a cleavage at the point, with the death within 24 hours of the posterior section.

Details of the band spectrum of indium hydride, observed in the region 5600–8500 A., are given by Dr. B. Grundström. The spectrum was obtained from an arc between electrodes of indium and carbon in hydrogen at high pressure.

Commenting on Prof. Dingle's dilemma that modern physics with its assumption that *only that which is logically or physically observable is significant*, leads one either to assume omniscience, or to deny the existence of the external universe, S. Van Mierlo points out that, by using reason in addition to sense perception, one always reaches the physically unobservable. He suggests that, in the statement of the principle, the word *physically* should be replaced by *essentially*. Prof. E. H. Kennard would avoid the dilemma by admitting that the limits of the observable are being continuously extended and that, for example, if a signal travelling with infinite speed were one day discovered, simultaneity would become observable (to observers moving relatively to one another). Prof. Dingle, in reply, considers that neither of these views solves the problem.

Research Items

Natives of Bentinck Island, Queensland

AN account of two islands, little known outside Australia, which lie off the coast of Queensland, is given by Mr. Ewen K. Patterson in *Discovery* of March. Of these St. Helena, about five miles from the east coast, was formerly a convict station and is now being converted into a pleasure resort. The second, Bentinck Island, is situated in the far south-eastern corner of the Gulf of Carpentaria and is rarely visited. The natives, who resent the approach of the white man, have not yet been studied at close quarters. Their number is unknown, though it is estimated at about five hundred. They have no habitations, but sleep on the ground uncovered, except for grass to keep off mosquitos, in all weathers. They wear no clothes and have resisted all attempts to civilize them. Such information as is available concerning them is derived from brief visits of missionaries and others. The island is densely covered with forest, in which the natives take cover when white men approach. They use no cooking or eating utensils, except large sea-shells, in which they carry and store water; smaller shells are used for drinking. Sharpened stones are used for opening oysters. Their food consists of oysters, fish, sharks, turtles, dugong and bush berries. All food is thrown into a fire and left to roast for a time, when it is seized and eaten in the hands. Fish are caught in primitive basket traps sunk in the sea, while turtles, dugong and sharks are speared. Canoes are unknown, but rafts are made of a type known nowhere else. These rafts resemble an elongated V, some measuring up to twelve feet in length and ten feet in width at the broad end. They are made of saplings or logs tied together with bark fibre and vines, the space between the saplings being filled with tightly rammed grass or a 'cement' made of clay, grass and small stones. They are propelled by long paddles resembling cricket bats in shape. The natives are expert in throwing a spear, which ranges in length from six to twelve feet, the heads being spines of stingray tails, bones, fire-toughened wood barbs, or pieces of sharp flint.

Large Flights of Shearwaters

THAT migration involves enormous mass movements of birds is obvious, but it is seldom that a computation of numbers can be made. On July 12, 1937, Henry E. Parmenter sighted a line of shearwaters off the coast at San Francisco flying northward at from three quarters to a mile off shore. The end of the line to the north could not be seen, so that it was impossible to estimate for how long the birds had been passing; from Point Pedro southwards as far as the eye (aided by a binocular glass) could see, the line was continuous and northbound. (*Condor*, **39**, 253; 1937). The observer moved southwards by car keeping the line of birds in view, so that he reached a point 30 miles in a direct line from where the birds had been first seen more than three hours before. If the birds were travelling at about 25 miles per hour (a modest estimate) they must have travelled about 80 miles in that time, so that the flight was at least 110 miles long. Some of the birds were settled upon the water in 'rafts' of varying extent, feeding. A raft one mile long and one eighth mile wide, allowing 10 square feet to a bird, would contain at least 359,000 birds. The author estimates conservatively that the number of birds seen by him and his companion on that occasion was at least 750,000. The species concerned was the sooty shearwater, *Puffinus griseus*.

Habitat and Habits of *Trochus niloticus*

THIS paper by H. Srinivasa Rao recently published (*Rec. Indian Mus.*, **34**, Pt. 1, 1937) deals with an important commercial mollusc. Its range is wide in the Indo-Pacific seas and it is common living among coral reefs and under rocky ledges. The author shows that there has been considerable depletion in the shell population due to continual fishing, the rate of collection per diver per hour having fallen from more than 20 in 1933 to 2–3 in 1935. It is a great wanderer within the limits of the reef surroundings, crawling up from about 7 fathoms on reaching maturity. The shallow waters are thus re-stocked. Its movements are very slow as it seeks food and shelter, the usual food being bottom deposits and fresh algæ. Two types of shell are sometimes regarded as specifically distinct, but they are here attributed to changes of shape probably due to differences of growth at various ages. Sexes are about equal. Females are sexually mature when the shells are about 9 cm. in diameter, males when they are about 6–7 cm. Breeding probably occurs throughout the year, but there are indications that during or immediately after the warm season there is an intensive spell. This species lives to be old and is known to attain ten years.

Swarming and Lunar Periodicity of a *Platynereis*

R. Gopala Aiyer and N. Kesava Panikkar describe interesting swarming habits in a species of *Platynereis*, probably new to science (*Proc. Indian Acad. Sci.*, 5, Sect. B, No. 6; 1937). The account of the heteronereid stage and the lunar periodicity in the swarming habits is submitted with the hope that it will lead to further observations on similar phenomena that may occur also in other localities on the Indian coast. The swarming habits were observed inside Madras harbour for a period of one year. All instances of swarming occurred between 7 and 10 p.m. on days of new moon and a day or two before or after. The time corresponds to the period of maximum high tide for that particular day. On every occasion the sea was calm and there was intense phosphorescence caused by *Noctiluca*. The syllids themselves do not produce light. An interval of three lunar months is observed between successive swarms, and swarming took place during the new moon in the months of March, June and September. No swarming was observed in December although special watch was kept on the day of new moon and the days before and after. The sea was very rough and there was no *Noctiluca*. The authors are of the opinion that the annual swarming has probably ceased with the September display, and occurred again in the March following.

Growth-controlling Substances in Plants

In a series of preliminary experiments with these substances, Dr. H. L. Pearse has examined the reaction of leafless woody cuttings to treatment with root-forming substances (*Ann. Bot.*, N.S. 2, No. 5, 227; 1938). The experiments were performed on leafless cuttings of *Salix vitellina*, and the synthetic root-forming substance was indole-butyric acid in lanolin paste in one series and indole-butyric acid dissolved in water in the other. Some interesting results were also obtained from partial and complete ringing. It was found that treatment of the basal end of cuttings stimulated root-formation at that end. If, on the other hand, the apical end was treated, root-formation was accelerated throughout the length of the stem, though acceleration was at a maximum at the node nearest the apex and the number of roots decreased from apex to base. Ringing experiments showed that the indole-butyric acid was transported downward in the stem through tissue outside the xylem. It is suggested that the indole-butyric acid itself was the active agent concerned in root formation, and was used up or chemically changed in the process, since when the portion of the base which had been treated was removed, the effect of treatment was eliminated, but if more indole-butyric acid was added, then further response occurred.

Effects of Variations in Atmospheric Carbon Dioxide

On February 16 a paper was read before the Meteorological Society which deals with a subject that has not occupied the attention of meteorologists very much hitherto, namely, the effect of variations in the amount of carbon dioxide in the atmosphere on the long wave radiation from the atmosphere to the earth, and the consequent effect on temperature. The particular variations with which the author, Mr. G. S. Callendar, is concerned, are those due to fuel combustion, and his subject amounts, therefore, to a study of the effect of fuel combustion on the mean temperature of the atmosphere of the earth, and so on climate. He calculates that the annual addition of carbon dioxide to the atmosphere from this source is 4,300 million tons, and by consideration of various other factors that control the amount of free carbon dioxide, such as the solution of the gas into the water of the oceans, arrives at 6 per cent as the calculated increase between 1900 and 1936, resulting from the fuel combustion. An examination of accurate determinations of the amount of carbon dioxide in the atmosphere, made by Brown and Escombe around 1900, and of recent determinations in the eastern United States, suggests that the actual increase and the calculated increase agree very well. The radiation absorption coefficients of carbon dioxide and water vapour are used to show the effect of the former upon the downward radiation of the atmosphere. The observed radiation is due mainly to infra-red absorption by varying amounts of water vapour and from the 3 parts in 10,000 of carbon dioxide normally present in the air. In temperate regions he calculates that with vapour pressure 10 millibars only 5 per cent of the radiation comes from the carbon dioxide, but that in polar regions the proportion is three times as great. A study of the effect of changes in the amount of carbon dioxide on the mean temperature leads to the conclusion that the observed and calculated artificial increase in recent years due to combustion is causing an increase of mean temperature at the rate of 0·003° C. per year. Temperature observations for the last fifty years from different parts of the world are examined and it is claimed that these show an increase at the rate of 0·005° C. a year.

Structure of Rubber

With the more extensive data from new X-ray diffraction patterns of stretched rubber an attempt has been made by H. A. Morss, jun. (*J. Amer. Chem. Soc.*, 60, 237; 1938) to find the true unit cell. No really satisfactory solution was reached but some points of interest are described. It appears that the carbon atoms of a molecular chain are not coplanar in stretched rubber. The reason appears to be the large repulsive forces which would have to exist in that configuration. In rotations on the single bonds during stretching and retraction the interatomic forces are probably repulsions in the dominating pairs, the prevailing H—H distances in the closest pairs suggesting repulsive rather than attractive forces. Repulsions give a plausible explanation of the form of the outer part of the stress-strain curve. A structural formula of rubber is proposed. The density of crystalline, stretched rubber as calculated from the unit cell is about 1·00 when the angle between the two independent sets of planes which reflect the two equatorial spots is changed from 90°, which first suggests itself, to 109·5°. This value agrees better with the experimental value 0·96 than the values calculated from other structures.

Production of Cosmic Ray Showers

The investigation of cosmic ray shower-production by counters only gives an indirect and clumsy analysis of the size of the showers, and M. A. Starr (*Phys. Rev.*, 53, 6; 1938) has examined the production of showers in lead by taking a large number (about 20,000) photographs in a Wilson cloud chamber containing a lead plate. The chamber was released by a coincidence counter arrangement, and the rays are therefore to some extent selected, but it is considered that this selection does not seriously interfere with the statistical conclusions. The frequency of showers of different sizes was studied as a function of the plate thickness. The results are consistent with the cascade theory of showers of Bhabha and Heitler and of Carlson and Oppenheimer. According to these views, energetic electrons lose energy by γ-ray formation and the γ-rays produce electron pairs which again give rise to γ-rays. The average size of a shower increases with the thickness of the lead layer. It is found that about 8 per cent of the electrons striking a 7-mm. lead plate give rise to showers, and that about an equal number of showers are produced by γ-rays. This probability of shower production is much less than expected if all the incident particles observed are electrons obeying the theory, and it appears that more than half the particles are anomalous from this point of view. R. B. Brode and M. A. Starr (*Phys. Rev.*, 53, 3) discuss the ten nuclear disintegrations producing heavily ionizing tracks which were observed in the course of the work. Since these disintegrations coincided in time with the passages of a cosmic ray particle through the counters, they are believed to be due to cosmic rays. They are interpreted as the 'evaporation' of particles due to violent excitation of the nucleus and a sharing of the energy among the nuclear constituents as suggested by Bohr's nuclear theory.

Constitution of the Ionosphere and the Lorentz Polarization Correction

By H. G. Booker and L. V. Berkner

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SOME years ago considerable discussion took place concerning the relation between the constitution of the ionosphere and its refractive index for radio waves. The question at issue was whether the force per unit charge exerted by the electric field of a radio wave upon an elementary charged particle in the ionosphere should be taken simply as the Maxwellian electric intensity E (the Sellmeyer theory), or whether there should be added a contribution $(4\pi/3)\mathbf{P}$ (the Lorentz theory), $\mathbf{P}$ being the electric moment per unit volume produced by the radio wave in the neighbourhood of the charged particle under consideration. The discussion culminated in a paper by Darwin[1] which is the most exhaustive treatment of the subject so far published. This seemed to point to the conclusion that on theoretical grounds one should expect the Sellmeyer theory to hold good in the ionosphere at radio frequencies.

A clear-cut experiment for deciding between the two theories was first indicated by Ratcliffe[2] and afterwards described in detail by Goubau[3]. The experiment depends on the fact that, for radio waves, the ionosphere is rendered doubly-refracting by the influence of the earth's magnetic field. Free electrons in the ionosphere gyrate around the earth's magnetic field with a frequency of the order of a megacycle per second. For wave-frequencies less than the gyromagnetic frequency there is, under suitable conditions, a clear-cut distinction in the behaviour of the extraordinary wave according to the two theories. The distinction should become apparent when measuring, by the well-known method of vertical radio-sounding of the ionosphere, the variation of echo retardation with wave-frequency below the gyromagnetic frequency in certain regions of the earth. Where the magnetic dip is greater than $\sin^{-1}(1/\sqrt{3}) = 35°$, but less than the value at which vertical propagation in the ionosphere at the wave-frequencies under consideration passes from quasi-transverse to quasi-longitudinal type, the distinction between the two theories is the following. According to the Sellmeyer theory, the virtual height of the extraordinary wave increases to infinity as the wave-frequency increases to the gyromagnetic frequency. However, on account of strong absorption of the extraordinary wave in the immediate neighbourhood of the gyromagnetic frequency, it would be quite impossible to trace the extraordinary wave to an enormous virtual height at a wave-frequency just below the gyromagnetic frequency. On the other hand, according to the Lorentz theory, the virtual height of the extraordinary wave increases to infinity as the wave-frequency increases to a value which we shall call the Lorentz frequency and which is definitely below the gyromagnetic frequency. Moreover, the absorption of the extraordinary wave just below the Lorentz frequency according to the Lorentz theory is less than it is just below the gyromagnetic frequency according to the Sellmeyer theory. In consequence there is a greater possibility of tracing the extraordinary wave to a great virtual height if the Lorentz theory is valid than if the Sellmeyer theory is valid.

At Kensington, Maryland, U.S.A., where the magnetic dip is between 71° and 72°, the Lorentz frequency, neglecting the effect of heavy ions, is about 17 per cent less than the gyromagnetic frequency. Moreover, the reflection coefficient of the extraordinary wave just below the gyromagnetic frequency according to the Sellmeyer theory is about four orders of magnitude less than it is just below the Lorentz frequency according to the Lorentz theory.

The accompanying figure reproduces one of a large number of records which have been obtained over the past year at the Kensington Experimental Station, using the automatic multifrequency equipment developed in this Department. Towards the lower end of the frequency-range these records show echoes the virtual heights of which increase with increase of wave-frequency and tend to infinity as the wave-frequency increases to 1·38 mc./sec. At a frequency slightly below 1·38 mc./sec. it is actually possible to recognize the individuality of successive echoes the wave-frequencies of which differ by known amounts, and to deduce that the virtual height is here increasing with increase of wave-frequency at about a hundred kilometres per kilocycle per second. We interpret these echoes as due to reflection of the extraordinary wave from the F-region of the ionosphere at wave-frequencies below the gyromagnetic frequency. The value of the gyromagnetic frequency at ground-level at Kensington is 1·61 mc./sec., and if it decreases with increase of height according to the inverse cube of the distance from the centre of the earth (as it should to a close approximation) it has the value 1·54 mc./sec. at a height of 100 kilometres and 1·44 mc./sec. at 250 kilometres.

One of the striking features of the record here reproduced is that the echo in question can be traced to the enormous virtual height of 1,600 kilometres before it finally fades out. This simple fact makes it obvious from the outset that it is impossible to explain these results in terms of the Sellmeyer theory without drastically reducing, in complete contradiction to accumulated experience, our idea of the order of magnitude of the damping experience by radio waves in the ionosphere.

It is important to realize that the large retardation experienced by these echoes is not taking place near the point of reflection. According to either the Sellmeyer or the Lorentz theory, most of the retardation and absorption of the extraordinary wave at these frequencies takes place where the electron density is something like a quarter of that required to reflect the wave. Since the frequencies in question cannot be much above the E-region penetration-

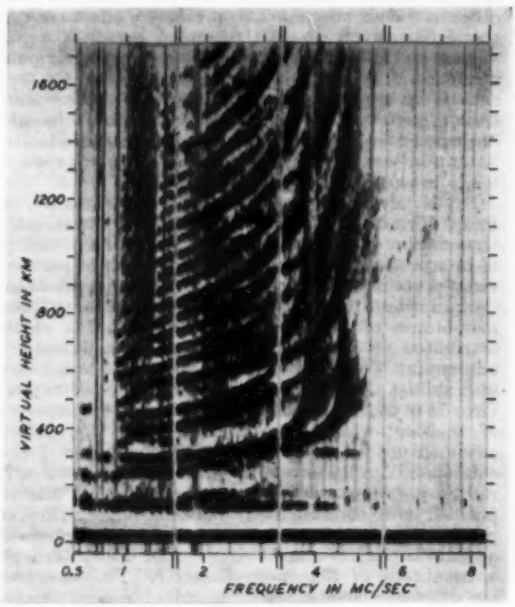
frequency for the extraordinary wave, and since there is reason to believe that considerable ionization exists between the *E*- and *F*-regions, one might expect on theoretical grounds that most of the retardation and absorption of these echoes would occur in the lower part of the *E*-region where the ionization density first becomes appreciable. This is confirmed experimentally by the multiple echoes which appear on most of the records. Prominent among these multiples are echoes which, in addition to having travelled up to the *F*-region and back again, have been reflected back and forth between the *E*- and *F*-regions one or more times, suffering partial reflection from the top of the *E*-region in a manner which is quite common but not fully understood. The consequent additional retardation suffered by these multiple echoes is found to be almost *independent of wave-frequency*. This confirms the expectations that the large retardation experienced by the echoes at wave-frequencies just below 1·38 mc./sec. takes place in the lower part of the *E*-region. Now we can prove from observations of the penetration-frequencies of the *E*-region that the value of the gyromagnetic frequency at the level where the waves penetrate the *E*-region is certainly greater than 1·50 mc./sec.

To interpret these observations in terms of the Sellmeyer theory, it would therefore be necessary to assume that the gyromagnetic frequency, which is proportional to the magnitude of the earth's magnetic field, varies with height above the surface of the earth in the following manner: (1) A decrease from 1·61 mc./sec. at ground-level to 1·38 mc./sec. in the lower part of the *E*-region, corresponding to an inverse tenth or eleventh power of the distance from the centre of the earth; (2) a sharp increase to a value greater than 1·50 mc./sec. at the level where the waves penetrate the *E*-region; (3) at greater heights the gyromagnetic frequency could decrease as the inverse cube of the distance from the centre of the earth in agreement with the theory of the earth's magnetic field. In addition it would be necessary to reduce the accepted estimate of the collisional frequency in the lower part of the *E*-region by more than an order of magnitude and at the same time to explain why the attenuation of radio waves in general is as great as it is. The interpretation of these observations in terms of the Sellmeyer theory would therefore seem to be out of the question.

Qualitatively there seems to be no objection to interpreting the results in terms of the Lorentz theory. To obtain a quantitative interpretation it is necessary to realize that good theoretical reasons exist for believing that considerable numbers of molecular ions are present in the lower part of the *E*-region and that these can materially affect the value of the Lorentz frequency. In interpreting our results in terms of the Lorentz theory we therefore choose the molecular ion-concentration to have the value which brings the Lorentz frequency to 1·38 mc./sec. The ratio of molecular ion-density to electron-density in the lower part of the *E*-region turns out to be about ten thousand. Observations of the penetration-frequencies of the *E*-region show that at the level where the waves penetrate the *E*-region this ratio has a value of the order of one thousand. Heavy ion-concentrations of these orders of magnitude do not seem unreasonable and are required in order to explain satisfactorily the diurnal variation of terrestrial magnetism.

It is hoped to publish in the near future a detailed discussion of the results and conclusions sketched above.

While this work was being prepared for publication, an account of similar, though apparently less complete, observations was published by Martyn and Munro[4]. But these authors' interpretation of the observations is entirely different from our own, and their conclusion diametrically opposite. The echo which we interpret as due to normal reflection of the extraordinary wave, they interpret as due to an abnormal reflection of the ordinary wave. We are at a loss to understand why Martyn and Munro completely ignore the possibility that splitting of echoes at wave-frequencies less than the gyromagnetic frequency may be due to normal double-refraction, which is the proved explanation of the familiar splitting of echoes at wave-frequencies greater than the gyromagnetic frequency. The question of whether the echo under consideration is due to reflection of the ordinary or extraordinary wave should be settled by observation of its elliptical polarization. It would appear that this has already been done by Farmer and Ratcliffe[5], who found the echo to have the elliptical polarization corresponding to the extraordinary wave in agreement with our interpretation, but who were unable to follow it to wave-frequencies sufficiently high to decide between the Sellmeyer and Lorentz theories.



THE RETARDATION OF THE EXTRAORDINARY WAVE BELOW THE GYROMAGNETIC FREQUENCY, KENSINGTON EXPERIMENTAL STATION, DECEMBER 16, 1937, 2h 15m–2h 30m, 75° WEST MERIDIAN TIME.

[1] *Proc. Roy. Soc.*, **A**, **148**, 17–46 (1934).
[2] *Wireless Engineer*, **10**, 354–363 (1933).
[3] *Hochfrequenz.*, **44**, 138–139 (1934).
[4] NATURE, **141**, 159–161 (1938).
[5] NATURE, **135**, 831–832 (1935).

Recent Developments of Plant Virus Research

A MEETING of the Royal Society held on March 17 was devoted to discussion of "Recent Developments of Plant Virus Research". The proceedings were opened by Dr. R. N. Salaman, who indicated the lines along which research is progressing. He then dealt in detail with problems arising from the existence of distinct strains within a plant virus, with special reference to potato virus X. Six distinct strains of this virus have been isolated at Cambridge. Wide differences in virulence exist between them, but their relationship is shown by the identity of physical characters and especially by the fact that presence of any one strain in a host prevents reinfection with any other of the six strains. This protective effect implies the existence of a radical common to all X virus strains and distinct from any which may determine virulence. From the differences between the reactions of some strains on potato and tobacco and from the effect of mixing strains with tobacco mosaic he deduced the presence of three or four more radicals. Attention was directed to the possibility of prophylactic inoculation for protection of field crops.

Dr. K. M. Smith discussed "The Ultrafiltration of Plant Viruses". He summarized work on the determination of particle size and stressed the difficulty of interpreting data obtained by filtration of purified virus proteins through graded collodion membranes. Certain plant viruses can only be made to pass membranes of pore size exceeding 400μμ, a result attributed to low virus concentration and loss by adsorption. Concentration of viruses leads to reduced filterability. Thus *Lycopersicum* virus 4 and *Nicotiana* virus II in fresh sap have estimated particle diameters of 18–20μμ, whilst in purified solutions the values obtained are 80–85μμ. With *Nicotiana* virus I the corresponding figures are 22 and 120μμ respectively, results partly explicable on the assumption that in purified and concentrated solutions aggregation of particles takes place. By use of a cataphoresis apparatus the last-named virus can be drawn through a membrane of 13μμ pore diameter. This indicates the existence of ultimate virus units having diameter about 4μμ.

Mr. F. C. Bawden described work on purification of crystalline and liquid crystalline virus proteins. From plants infected with tobacco mosaic a nucleoprotein has been isolated, solutions of which have a satiny sheen. When such a solution is slowly concentrated, it becomes viscous, and when shaken the resultant gel breaks up into microscopic needles. A strong solution allowed to stand separates into two liquid layers; the lower and more concentrated is completely birefringent whilst the upper exhibits anisotropy of flow. The difference between the layers has thus been attributed to more perfect orientation of suspended rod-shaped particles in the lower solution. In the host cell the 'X' bodies are not birefringent, but the striate material peculiar to this virus exhibits birefringence along the transverse axis and suggests formation of true virus crystals in the plant, although infected host sap represents only a 0·2–0·3 per cent concentration of virus protein. Great differences may be inferred between the state of virus particles in the host and in purified preparations; the latter are much less infective and show greater anisotropy of flow than a clarified sap of similar concentration. The virus of tomato bushy stunt is also a nucleoprotein, but its purified preparation shows no anisotropy of flow and crystallizes in perfect rhombic dodecahedra.

Prof. J. D. Bernal described the conclusions drawn from X-ray study of the structure of the virus protein molecule. No difference in intramolecular structure can be detected between liquid crystalline proteins isolated from different strains of tobacco mosaic. All have the regular internal crystalline structure characteristic of such proteins as the globulins, and their molecules apparently consist of a number of primary units of dimensions $6 \times 6 \times 6 \cdot 9\mu\mu$. In solutions and gels the particles themselves are also regularly related to each other. The distance between them depends on the concentration of the suspension, but even in a 20 per cent solution an orderly arrangement is maintained. The minimum distance recorded, that in a dried gel, was 132 angstroms, which indicates one dimension of the particle. The corresponding figure for cucumber mosaics 3 and 4 is 135. In plant sap, on the contrary, it was suggested that the virus units of tobacco mosaic are approximately equidimensional, with molecular weight of the order of 200,000 and a size of 120 angstroms.

Dr. MacFarlane dealt with the physical properties of vaccinia, shown by ultracentrifuging to consist of particles of unequal size. Methods were described for determining the density of vaccinia in the undried state, and it was suggested that the vaccinia particle consists of a protein molecule surrounded by an atmosphere of closely bound and orientated water ions. This atmosphere is gradually removed when vaccine is suspended in sucrose solution, while in flocculated virus no water remains. Such a structure implies the impossibility of metabolic reactions on the part of the protein nucleus.

Dr. Findlay summarized the evidence for the existence of strains in animal viruses and pointed out that such strains do not necessarily counter-immunize. Special stress was laid on variation induced by cultivation in unfavourable host tissue, but such altered strains are liable to reversion. Most apparent cases of alteration in properties are probably due to selection from a previously heterogeneous population of strains.

Mrs. Watson discussed the relation of some plant viruses to *Myzus persicæ*. Starvation of the aphis before feeding on the infected plant results in great increase in infectivity, but this effect is lost if the duration of feeding exceeds an optimum period. In the case of *Hyoscyamus* virus 3 and potato virus Y, this period is two minutes; in the case of cucumber mosaic it is fifteen minutes. No direct relationship can be demonstrated between transmissibility by *M. persicæ* and concentration of virus in the plant as estimated by the starch local lesion test.

A general discussion followed, during which Prof. P. A. Murphy stressed the importance of multiplying completely virus-free potato stocks on a commercial scale. Different environments have distinctive virus populations and hence dangers arise from the use of 'masked' plant virus strains as vaccines. Dr. Elford commented on the advisability of reducing adsorption in ultrafiltration work and suggested the use of broth as a medium for re-suspension of purified plant viruses.

Irrigation of Dry Hill Sal Areas in India

THIS subject is discussed by Mr. W. P. M. Warren in the *Indian Forester* of April of last year. Those who have had an acquaintance with the considerable areas of poor open decrepit forest which cover the hills in what was formerly known as Chota Nagpur in the old Bengal Province will be interested to learn of the remarkable experimental work being carried out in a part of this area at Bamiaburu, some twenty miles distant from Chakardharpur on the Bengal-Nagpur Railway. The work so far undertaken has led to results of considerable importance, when it is mentioned that some five sixths of the Bihar forests consist of this worthless type of forest. Of greater value, however, is their apparent opportunity for experimental work on a wider basis in parts of the world where the activities of man are resulting in appalling floods and bad soil erosion.

Briefly, a scheme was commenced in 1933 at Bamiaburu with the object of arresting the run-off water from hillsides by making a system of contour channels. By this means the water percolates down through the soil instead of running to waste. This delayed run-off on an extensive scale would possibly prove a solution for flood problems, by permitting the plain's water, which in any event would be less in quantity, to get away first. As a result of this holding up of the water by the contour channels, remarkable growth is already becoming evident in areas where formerly hollow stagheaded drought-stricken trees prevailed; blanks are filling up with regeneration and the density of stocking is increasing. The cost of the work is low, Rs. 100 per mile only, if dry rubble bunds (walls) for crossing nullahs are made instead of something more expensive. Observations taken during the last year or two have shown that the night temperature in April in the area at present under treatment (height 1,250 ft.) under steady meteorological conditions was equivalent to that experienced at 3,000 ft. in these parts. Humidity and rainfall in May (1936), under disturbed atmospheric conditions were higher than at any other recording station nearby, though its situation and topography were less favourable than at one station. Clouds in the latter half of this month spread each evening over the areas, with the often purely local precipitation of rain. Additional light showers during the day fell only in the area itself, and not outside, and so were not recorded. Mr. Warren does not pretend to be a meteorological expert. No recording station with a similar situation to Bamiaburu exists in the neighbouring areas, and he had not the advantage himself of proper equipment. He therefore only summarizes actual experiences and records obtained. It is too early to claim too much from this remarkable experiment. But to those formerly acquainted with this, in April and May, torrid region, the results so far attained appear to open great possibilities.

That this contour-channel method is not a new idea, in India at least, is shown in an article by Dr. R. M. Gorrie, in the May issue of the *Indian Forester*, on that evergreen theme, the erosion in the Pabbi Hills in the Gujrat District in the Punjab. This problem is more than half a century old, the country having been taken over by the British in 1857, some attempts at regulating the grazing on this arid and already heavily eroded mass of foothills rising out of the plain being made about 1877. At this period the erosion was considered in connexion with the North Western Railway line. In the early 1880's reclamation and protection work were taken in hand by the late J. H. Lace. One of the methods introduced by Lace was trenching dug along the contours of steep slopes to catch and hold water for the use of tree seedlings on the berm.

Lace's work was successful, but Government soon let it drop, and the subsequent history of the Pabbi is depressing reading. What has forced the Pabbi erosion question to a head in modern times is the building of the Upper Jhelum Canal. This work is being affected to a serious extent by the enormous masses of silt brought down in the sudden floods, and considerable sums of money have had to be spent on protective works to the canal system from this cause alone.

Scientific Tests of a Vaudeville Telepathist

BULLETIN 3 of the University of London Council for Psychical Investigation consists of a detailed study by S. G. Soal of the hyper-acuity of the senses that is made use of by Josef Kraus ("Marion"), either consciously or unconsciously, in producing his demonstrations of telepathy and clairvoyance. The interest of this report is enhanced by the fact that it is the first scientific research into this subject, and it need scarcely be pointed out that the precautions that have to be taken when human beings are the material of the experiment far exceed those necessary in other branches of science. As an exposition of these precautionary measures alone, the Bulletin is quite outstanding and should be carefully studied by everyone interested in psychical research. Incidentally, the facts disclosed in this research throw very grave doubt on the supposed proofs of telepathy and clairvoyance that have recently received considerable publicity, and in particular those of Dr. J. B. Rhine in the United States.

In Section 1, a statistical study of the results of experiment shows that Marion can rapidly locate small objects that have been hidden by a small audience who know the hiding-place and whose involuntary movements he is able to observe. Similarly, he can determine an imaginary hiding-place concentrated on by the audience when no actual object is hidden. But he cannot improve on chance results if the audience is screened from his view, or if no one in the room is consciously aware of the

hiding-place. This indicates that he gets visual indications of small unconscious movements by one or more persons in the audience.

In another series of experiments, Marion exhibited a power superior to that of Cumberlandism or muscle-reading by finding hidden objects when followed by a single person who knew the hiding-place. Progressive covering up of this agent by a wooden box showed that Marion could still succeed even when he could see no more than the agent's feet. If the agent was totally covered and wheeled round the room, failure ensued. In this case slight changes in the movements of walking appear to be the principal *indicia*. This result clearly indicates that in any telepathic experiment the agent should not be visible to the percipient.

In Section 2, Marion's power of recognizing cards which he had previously handled, when mixed in a new pack, is studied, and it is shown that this is probably due to tactual discrimination of a high order. His departure abroad prevented experiments to see if he could emulate the blind osteopath, Captain Lowry, by distinguishing the pips on a playing-card by sense of touch alone.

Further statistical and other tests in telepathy and clairvoyance are described in Section 3; but no evidence was provided of any faculty for reading the contents of sealed envelopes or of divining numbers thought of by members of an audience. Marion's claims as regards graphology and psychometry also seem to be without foundation.

Transatlantic Steam Navigation a Century Ago

JUST when the S.S. *Sirius* and the S.S. *Great Western* were being advertised to sail on their first passages to New York, and on the day, March 31, 1838, the *Great Western* left the Thames for the Severn, preparatory to starting on her voyage on April 8, the *Athenæum* published an article running to four pages under the title "Atlantic Steam Navigation". This was one of several articles in the same journal all of which were written with a good knowledge of the subject and in an unprejudiced manner. From the article which appeared in the issue of March 31, the following passages are taken:

"There is really no mistake then in this long talked of project of navigating the Atlantic Ocean by steam. There is no doubt, that is, of the existence of the intention to make the attempt, and to give the experiment, as such, a fair trial. Nor is the intention entertained (like many innovations sometimes more ingenious than will bear much examination) by an irresponsible party, or by one party alone, as we shall presently show. The whole commercial community, at least of our own country, and we may add of the United States, are alive to its interest. In Liverpool, New York and the 'Great Metropolis'—the three depots of the mercantile navigation of Christendom . . . the work goes bravely on. The *Sirius* is absolutely getting under weigh, while we write this paragraph, for America New York, via Cork! The buzz of excitement yesterday reached even the secluded walls of our own study. We rushed down to Blackwall pell-mell, in an omnibus, like all the rest to see not the *Sirius* but the *Great Western*, which the papers have told us so much about for a month past. . . . Groups of nobility and gentry, with his Grace of Wellington at their head, figured in the cabin album; and we met as we came back, the Lord Mayor with his state carriage and four footmen rolling in gold, dashing down to Blackwall to get a last glimpse; all in pursuit, in a word, of the great animals of the day—the steamers now starting for the other side of the Atlantic.

"There is no mistake, then, we repeat, as to the trial of the experiment."

The writer of the article then went on to deal with the *Sirius*, the *Great Western*, the companies, the construction of the *British Queen* at Limehouse, the charges to be made for passengers and letters, the attitude of the Liverpool shipowners and other matters. "Our space," he concluded, "is now small for discussing anew the policy or subsequent prospects of this scheme. We consider it, however, in that view, a subject of very considerable importance, as well as of the most curious and teeming interest. If sustained, there can be no doubt of its vast advantage in *speed*. . . . For the mails, for the immense and vastly increasing correspondence between the two countries, for all personal intercommunication of mercantile men . . . this is a vital and conclusive point. We must count also on an increase in travelling, if not of trade. . . .

"We think the sum of it, for the present, may be taken thus:—the practicability of steam will be established at once. Its speed and its certainty will induce interests, enough for its maintenance, to a greater or lesser extent to support it. All correspondence will be conveyed by it; all mercantile travel and some goods. Most passengers may be shy of it for a time—many for a long time (as some are of railroads still); accidents will happen of course; still the scheme will go on to maturity. Of its influence on other and far greater interests than yet alluded to, we cannot now speak. This is a scheme not to be hastily treated. It is one, too, which may be deferred awhile. All eyes now are turned on the "*commencement* of the end". We may yet discuss with improved data, the *end* of such a beginning."

The *Great Western*, the first steam vessel designed for the Atlantic passage, it may be added, was 212 ft. between perpendiculars, 35 ft. wide inside the paddle boxes and on a draught of 16 ft. 8 in. displaced 2,300 tons. Built of wood, she was strengthened in an elaborate manner by diagonal trussing of wood and iron and was copper sheathed. She had four boilers designed to work at 5 lb. pressure and her engines developed about 750 horse-power. Her machinery weighed nearly 400 tons and she stowed about 600 tons of coal. She left Blackwall early on March 31, 1838, and when she was between Gravesend and Southend a fire broke out around the base of the funnel which threatened to spread to the ship. The fire, however, was got under and the ship eventually left the Severn on her maiden voyage on April 8.

University Events

CAMBRIDGE.—At Trinity College, Prof. W. L. Bragg, Cavendish professor of experimental physics and former director of the National Physical Laboratory, has been elected into a professoral fellowship.

At King's College, J. W. S. Pringle and K. H. Harrison have been elected into fellowships. Mr. Pringle was educated at Winchester College, was placed in the first class of both parts of the Natural Sciences Tripos, was awarded the Amy Mary Preston Read scholarship in 1937 and appointed a University demonstrator in zoology. Mr. Harrison was educated at Bootham School, placed in the first class in both parts of the Natural Sciences Tripos and awarded the Benn W. Levy Research Studentship in biochemistry in 1936.

LEEDS.—Mr. W. E. Adams has been appointed lecturer in histology and will take up his duties at the beginning of next session.

OXFORD.—The Rolleston Memorial Prize of the value of about £100 is awarded every two years for original research in animal and vegetable morphology, physiology and pathology, or anthropology. Memoirs already published may be submitted and graduates of Oxford or Cambridge or research students are eligible. Further information can be obtained from the Registrar of the University, Oxford, to whom the memoirs should be sent before March 31.

The next award of the Radcliffe Prize, which is of the value of £50, will be made in March 1939. It is awarded for research in any branch of medical science and is open to all graduates of the University who are proceeding to a medical degree at Oxford. Further information can be obtained from the Secretary of the Faculties, University Registry, Oxford.

Societies and Academies

Paris

Academy of Sciences, January 24 (*C.R.*, **206**, 221–288).

JEAN CABANNES and JEAN DUFAY: The yellow radiation of the night sky. Utilizing numerous photographs made at Montpellier, the wave-length of the yellow line is found to be 5894 ± 1 A. The possibility of this line being produced by the emission of sodium atoms in the upper atmosphere is considered.

CHARLES EUGÈNE GUYE: Rectification of the note of January 4 on the possibility of verifying experimentally the relation $\nu = \nu_0 \sqrt{1 - \beta^2}$ of limited relativity.

RAPHAËL SALEM: The convergence *presque partout* of certain trigonometrical series.

PAUL LÉVY: The variation of the maximum of a function.

LUCIEN HIBBERT: The solution of algebraical equations of the form $z^n = z - a$.

CARLOS BIGGERI: Some theorems on the peripheral singularities of Taylor's series.

ALBERT MÉTRAL and FRANÇOIS RAYMOND: A method of measuring the resistance caused by the air on a railway train.

ADOLPHE FESTRAETS: The Stroobant (star) stream.

BERNARD KWAL: The indetermination of electromagnetic potentials.

OUANG TE-TCHAO: The spectrum of mobilities of the large ions.

NOEL FELICI: The equilibrium of supra-conductors.

ROBERT PINOIR: A new method of stabilization of the anodic current of electronic valves with respect to variations of the plate potential.

MICHEL CYMBOLISTE: The relations between the state of the surface of electrolytic chromium, its structure and its mechanical properties.

F. REDSLOB and H. FORESTIER: Study of the reactions of the formation of the ferrites of tin and cadmium.

GEORGES COSTEANU and PAUL RENAUD: The actions of water, hydrogen sulphide and iodine on sensitive surfaces.

ANDRÉ CHRETIEN and GUSTAVE OECHSEL: The use of acetyl chloride as a chlorination agent in inorganic chemistry. Acetyl chloride reacts with various metallic oxides (UO_2, V_2O_5, MnO_2). The apparatus used for the isolation and purification of the products is described and illustrated.

MLLE. YVONNE GARREAU: The action of thiochronic acid and of 2·5-dichlorhydroquinone-3·6-disulphonic acid on the primary amines. Constitution of the latter acid and of euthiochronic acid.

GEORGES LAUDE: The influence of some factors on the formation of ammonia by boiling proteins with alkaline solutions of potash.

ALBERT MICHEL-LÉVY and JEAN WYART: The utilization of the high temperatures and high pressures realized in the detonation of explosives for the artificial reproduction of minerals: zincite and willemite. Starting with a precipitate of amorphous silica in a brass container, the detonation of an explosive gives crystallized willemite.

MARCEL CHICHERY: The stratigraphy of the Dinantian formations of the Ardoisière basin, near Vichy (Allier).

GEORGES CHOUBERT: The Dogger of the Hauts-Plateaux and of the middle Moulouya.

HUBERT GARRIGUE: A study of the variations of temperature of the free air at the edge of an aeroplane.

ROGER FAILLETTAZ: Recording atmospherics and storm predictions.

MAURICE BURGAUD: Magnetic observations in China. Tabulated results from 38 stations in China, reduced to January 1, 1937.

FRÉDÉRIC MARIE BERGOUNIOUX: The discovery of a fossil tortoise in the Permian of Saint-Christophe (Aveyron).

ANDRÉ SARAZIN: The nuclear evolution of the basidia and of the basidiospores in *Agaricus campestris*.

RENÉ SOUÈGES: The embryogeny of the Campanulaceæ. The development of the embryo in *Jasione montana*.

RAYMOND CAHEN and E. MOISSET DE ESPANÈS: The cardio-vascular effects of the fluid extract of *Gelsemium sempervirens*.

LOUIS GALLIEN: The action of dihydrofolliculine benzoate in the differentiation of sex in *Rana temporaria*.

ALBERT VANDEL: The action of X-rays on the terrestrial Isopod *Trichoniscus(Spiloniscus)provisorius*,

Dublin

Royal Dublin Society, January 25.

V. C. BARRY: The preparation, properties, and mode of occurrence of laminarin.

J. CARROLL: Mineral oils as insecticides. An outline of the extent to which kerosene has been used in the past and of recent research on the use as insecticides of other fractions and grades of mineral oil. A full account is given of the utilization of lubricating oil emulsions, miscible oils, white oil emulsions, and combined tar-distillate and mineral oil sprays. Combination mineral oil and fungicide sprays are discussed, with suggestions as to promising lines for further research.

O. ROBERTS and J. DOYLE: The *p*H of conifer leaves in relation to systematy. Individual variations in *p*H are small. Seasonal variations, though also small, seem definitely related to seasonal metabolic changes. From the examination of more than ninety species it appears that there is a strong tendency in conifers for natural affinity to be expressed in similarities of metabolism, which are shown by correspondence, often very definite, of the *p*H range of the related groups.

Amsterdam

Royal Academy (*Proc.*, 41, No. 1, Jan. 1938).

H. Y. JORDAN and J. GUITTART: Regulation of the breathing of *Astacus fluviatilis*. The river crawfish reacts by hyperventilation to lack of oxygen as proprioceptive stimulus.

H. A. KRAMERS: Use of 'grand ensembles' in statistics. Remarks on the application of Gibbs's methods in classical and quantum statistics.

J. G. VAN DER CORPUT: Two, three or four primes (2).

P. ERDÖS: Additive properties of squares of primes.

C. S. MEYER: An integral representation of the Whittaker function.

J. F. KOKSMA: Metric considerations on the approximation of real numbers.

G. C. HIRSCH and J. W. SLUITER: Change in the structure and shape of the Golgi bodies in the primary yolk of the hen's egg and the 'system theory' of the Golgi bodies.

P. C. FLU: Investigation into the phage content of phage-containing globulin repeatedly precipitated by means of ammonium sulphate.

P. J. HARINGHUIZEN and D. A. WAS: A research on thin layers of tin and other metals. (4) Further investigation on the corrosion by oils. Experiments on the corrosion of iron and cadmium by lubricating oils, and of tin, iron and copper by olive oil and salad oil.

Cracow

Polish Academy of Science and Letters, January 10.

W. JACYNA, L. MALIS and A. OBNORSKY: Critical remarks on the thermodynamic scale below 1° K. The method used by Kürti, Lainé and Simon is considered incorrect. A thermomagnetic equation of sufficient exactness is indispensable.

T. BANACHIEWICZ: Control relations for the multiplication of Cracovians.

J. ZAWADZKI and MLLE. A. ULINSKA: The dissociation of zinc carbonate and the action of carbon dioxide upon zinc oxide. Contribution to the mechanism of reactions of the type $A_{sol} = B_{sol} + C_{gas}$.

J. TOKARSKI: The petrographic analysis of the tufas of Berestowiec.

J. ST. MIKULSKI: Experimental researches on the thermal ecology of eggs in the course of development of some tail-less Amphibians (*Rana*, *Bufo*, *Pelobates*).

MLLE. J. ACKERMANN: Experimental histochemical researches on the metabolism of lecithin in the animal organism. The influence of the ingestion of lecithin on the lipid content in the liver.

S. SKOWRON and Z. WICINSKI: Factors determining the duration of the yellow bodies.

Moscow

Academy of Sciences (*C.R.*, 17, No. 8, 1937).

P. P. DOBRONRAVIN: A possible interpretation of the new system of the TiO bands in the infra-red.

F. M. ŠEMIAKIN and P. F. MIKHALEV: Probable mechanism of the formation of periodic ice streaks in the course of soil freezing, with reference to the problem of permanently frozen subsoil.

B. DERIAGIN: A device for the investigation of the sensitivity of eye to the ultra-short illumination.

N. S. KURNAKOV, I. B. FEIGELSON and A. G. BERGMAN: Cyclochronograms of salt lakes. Lake Elton (1932–1936).

E. V. ZMAČINSKIJ: Reaction for the differentiation of fruit sugar from grape sugar.

M. P. VOLAROVIČ and L. I. KORČEMKIN: Connexion between the viscosity of molten rocks and the acidity coefficients according to F. J. Loewinson-Lessing.

M. P. VOLAROVIČ and A. A. LEONTJEVA: Investigations on the viscosity of obsidians, with reference to the problem of genesis of pumice stone.

D. KOSTOFF: Size of *Nicotiana rustica* L. × *Nicotiana tabacum* L. hybrid embryos and hybrids in respect to their parents.

G. H. MOLOTKOVSKIJ: A porometer for investigations under natural conditions.

G. M. PSAREV: Influence of the alternation of day and night on the nature of the variation in the duration of the various phases of development in soya.

M. I. MENŠIKOV: New data on the distribution of fishes in the basin of the Irtysh.

A. A. VOITKEVIČ: Morphogenetic activity of various parts of hypophysis. (10) The mechanism of the action of the basophile elements of the anterior hypophysis lobes on the feathers of birds.

C.R., 17, No. 9, 1937.

A. GELFOND: A generalization of the inequality of Minkovski.

S. SOBOLEV: A class of integro-differential equations with several independent variables.

N. ACHYESER: The best approximation in a class of constant periodic functions.

A. MARKOFF: Existence of an invariant integral.

S. I. WAWILOW: Nature of the elementary sources of light and the interference phenomena.

A. I. ALICHANIAN and A. S. ZAVELSKIJ: (1) The low-energy region of the β-spectrum of radium E. (2) The low-energy region of α-spectra of thorium C″ and thorium B.

I. KOUKLES and N. PISKOUNOV: Tautochromic vibrations in conservative and in non-conservative systems.

M. M. KATZNELSON and D. A. BRODSKY: Hexahydro-benzil-barbituric acids.

K. I. MAKOV: Cimmerian deposits in the Skadovsk district, Ukrainian S.S.R.

N. N. KONSTANTINOV: Some interspecific crossings in the genus *Gossypium*.

V. A. HIŽNIAK: Wheat-quitch amphidiploids.

F. UKRADYGA and A. OLEKSIJUK: Nutritive media for sugar beet in sand and water cultures.

V. G. ALEKSANDROV and O. G. ALEKSANDROVA: Mosaic of wheat endosperm.

N. S. PETINOV and P. S. BELIKOV: Continuous supply of plants with water as an indispensable condition of high yields.

B. I. BALINSKIJ: Production of supernumerary balancers in deficiency experiments in *Triton* embryos.

Washington, D.C.

National Academy of Sciences (*Proc.*, 24, 1–52, Jan. 15).

S. GAPOSCHKIN: Asymmetry of light curves in the 'great sequence' as a function of frequency of period.

B. J. BOK and E. M. LINDSAY: Stellar distribution in the vicinity of a southern galactic window.

E. H. MYERS: Present state of our knowledge concerning the life-cycle of the Foraminifera. For many of these organisms, now extensively used in problems of stratigraphical geology and as guide fossils in petroleum geology, the life-cycle consists of an orderly succession of sexual and asexual phases, leading to dimorphism of the test or shell.

G. A. MILLER: Groups having a maximum number set of independent generators.

M. RICHARDSON: Special homology groups.

H. S. UHLER: Log π and other basic constants. The fundamental formula underlying the work is a formula for π given by Ramanujan. By its use, with machine calculation, values are given for $\frac{1}{2}\log_{10} 2\pi$, $\log_e \pi$, $\log_{10} \pi$, $\log_{10} 2$, $\log_{10} 3$, $\log_{10} 5$, $\log_{10} 7$, $\log_e 17$, $\log_{10} 17$, $\log_e 71$, $\log_{10} 71$, $\log_e 113$, $\log_{10} 113$, $1/\pi$ and π^2, most of them to more than 200 places of decimals.

A. FIALKOW: Einstein spaces in a space of constant curvature.

E. KASNER and J. DE CICCO: Classification of element transformations by means of isogonal and equi-tangential series.

J. W. CALKIN: Abstract self-adjoint boundary conditions.

J. VAN OVERBEEK: A simplified method for auxin extraction. The auxin was extracted from uncrushed material with ether alone, and its concentration is expressed in terms of hetero-auxin (indole-3-acetic acid).

E. B. FRED, P. W. WILSON and O. WYSS: Light intensity and the nitrogen hunger period in the Manchu soybean. Plants exposed at an early stage to intense sunlight are unable to fix atmospheric nitrogen, due apparently to high carbohydrate-nitrogen ratio. By shading a plant for a few days or by addition of combined nitrogen (calcium nitrate), it responded quickly, the leaves becoming green and nitrogen fixation established, due apparently to the change effected in the carbohydrate-nitrogen ratio.

Forthcoming Events

Monday, March 28

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Film of "Australian Aboriginal Tribes", lent by the British Museum.

ROYAL SOCIETY OF ARTS, at 8.—Dr. M. A. H. Tincker: "The Growth of Plants in Relation to Cultivation" (Cantor Lectures. Succeeding lectures on April 4 and 11).

Thursday, March 31

BRITISH SOCIETY FOR INTERNATIONAL BIBLIOGRAPHY (at the Science Museum), at 5.15.—B. V. J. Brajnikoff: "Abstracting Russian Literature".

Friday, April 1

ROYAL INSTITUTION, at 9.—Sir Frederick Keeble, F.R.S.: "Humphry Davy, Farmer."

CHEMICAL SOCIETY, March 31–April 1.—Annual General Meeting to be held in Manchester.

April 1.—Prof. G. Barger, F.R.S.: Pictet Memorial Lecture.

BRITISH PSYCHOLOGICAL SOCIETY, March 31–April 4.—Extended General Meeting to be held in the University of St. Andrews.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

HEAD OF THE CHEMISTRY DEPARTMENT of the Coventry Technical College—The Director of Education, Council House, Coventry (March 26).

JUNIOR MAINTENANCE ENGINEERS at the B.B.C.—The Engineering Establishment Officer, B.B.C., Broadcasting House, London, W.1 (March 29).

PLANT PATHOLOGIST in the Department of Agriculture for Scotland—The Secretary (Establishment Branch), 29 St. Andrew Square, Edinburgh, 2 (March 31).

CHEMIST, PHYSICISTS, BACTERIOLOGIST AND JUNIOR CHEMIST to the Wool Industries Research Association, Torridon, Leeds, 6—The Secretary (March 31).

SCIENTIFIC OFFICERS and JUNIOR SCIENTIFIC OFFICERS in the Department of Scientific Research and Experiment, Admiralty—The Secretary of the Admiralty (C.E. Branch) (April 2).

ASSISTANT (Grade III—chemistry) in the Department of Scientific Research and Experiment, Admiralty—The Secretary of the Admiralty (C.E. Branch) (April 2).

ASSISTANTS (Grades I and II—mathematics) in the Department of Scientific Research and Experiment, Admiralty—The Secretary of the Admiralty (C.E. Branch) (April 2).

PHYSICIST in the Radon Department, St. Bartholomew's Hospital, E.C.1—The Acting Clerk to the Governors (April 4).

JUNIOR SCIENTIFIC OFFICER in the Wood Chemistry Section of the Forest Products Research Laboratory, Princes Risborough, Aylesbury, Bucks—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S.W.1 (April 9).

LECTURER IN MECHANICAL AND MARINE ENGINEERING in the City Technical College, Liverpool—The Director of Education, 14 Sir Thomas Street, Liverpool, 1 (April 11).

PROFESSOR OF CHEMISTRY in the University of Sheffield—The Registrar (April 23).

DEMONSTRATOR IN MATHEMATICS in the Imperial College of Science, Prince Consort Road, South Kensington, S.W.7—The Secretary (April 26).

ASSISTANT LECTURER IN SOCIAL PSYCHOLOGY in the London School of Economics—The Secretary, Houghton Street, Aldwych, W.C.2 (April 30).

LEVERHULME FOUNDATION FELLOW and LECTURER IN PHYSICS in the University of Liverpool—The Registrar (May 1).

PROFESSOR OF CHEMISTRY in the Indian Institute of Science, Bangalore—The Registrar (June 1).

CHIEF MECHANICAL ENGINEER AND TEMPORARY CHEMISTS in the Royal Naval Cordite Factory, Holton Heath, Dorset—The Secretary of the Admiralty (C.E. Branch, II), London, S.W.1.

LECTURER IN MECHANICAL ENGINEERING in the Borough Polytechnic, Borough Road, S.E.1—The Principal.

LECTURER IN AIR-CONDITIONING in the Borough Polytechnic Borough Road, S.E.1—The Principal.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Carnegie Trust for the Universities of Scotland. Thirty-sixth Annual Report (for the Year 1936–37) submitted by the Executive Committee to the Trustees on 16th February 1938. Pp. iv+90. (Edinburgh: Carnegie Trust for the Universities of Scotland.) [212

Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the Year 1936. Part 2. Pp. iv+83. (London: H.M. Stationery Office.) 1s. 6d. net. [212

University of Oxford: Bureau of Animal Population. Annual Report, 1936–37. Pp. 38. (Oxford: Bureau of Animal Population.) [222

British Chemical Plant, 1938. Official Directory. Pp. 170. (London: British Chemical Plant Manufacturers' Association.) Free. [222

An Index to Acts of Parliament and Statutory Rules and Orders affecting the Chemical Industry. Supplement No. 1 to second edition. (Published for the Association of British Chemical Manufacturers.) Pp. 8. (Cambridge: W. Heffer and Sons, Ltd.) 6d. [232

British Broadcasting Corporation. Eleventh Annual Report, 1937. (Cmd. 5668.) Pp. 32. (London: H.M. Stationery Office.) 6d. net. [252

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 771, Vol. 237: The Royal Society Expedition to Montserrat, B.W.I.: Final Report. By C. F. Powell. Pp. 34+5 plates. 7s. 6d. No. 772, Vol. 237: The Shadow of a Straight Edge. By E. T. Hanson. Pp. 35–66. 4s. No. 773, Vol. 237: The Computation of Fermi-Dirac Functions. By J. McDougall and Edmund C. Stoner. Pp. 67–104. 5s. (London: Cambridge University Press.) [282

Scientific Horticulture (formerly the H.E.A. Year Book): the Journal of the Horticultural Education Association. Vol. 6, 1938. Pp. 260+xxxii+20 plates. (Wye: South-Eastern Agricultural College.) 4s. net. [13

University of London: University College. Annual Report, February 1937–February 1938. Pp. 178. (London: Taylor and Francis.) [23

Exploration. Edited by Mabel M. Barker. Pp. 12 (interleaved). (London: The Le Play Society.) 4d. [23

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1787 (2821): Tests on a Single Section of R. 100 at Cardington. By T. S. D. Collins and L. Chitty. Pp. 86+2 plates. 12s. net. No. 1788 (2845): Estimation of Increase in Lift due to Slipstream. By R. Smelt and H. Davies. Pp. 20. 3s. net. No. 1794 (2908): Lateral Stability of a Single-Engined High Wing Monoplane with Airscrew Running—Yawing Moments due to Sideslip and Rudder Power. By G. A. McMillan, L. W. Bryant and A. G. Gadd. Pp. 41+2 plates. 6s. net. No. 1795 (2655): Forced Oscillations of Aeroplanes, with Special Reference to von Schlippe's Method of Predicting Critical Speeds for Flutter. By Dr. R. A. Frazer and W. P. Jones. Pp. 26. 3s. 6d. net. (London: H.M. Stationery Office.) [43

Other Countries

India Meteorological Department. Scientific Notes, Vol. 7, No. 74: The Rainfall in the Indian Peninsula associated with Cyclonic Storms from the Bay of Bengal during the Post-Monsoon and Early Winter Seasons. By K. P. Ramakrishnan. Pp. 65–74+8 plates. (Delhi: Manager of Publications.) 1.10 rupees; 2s. 9d. [222

Report of the Aeronautical Research Institute, Tōkyō Imperial University. No. 159: Influence of Number of Blades on the Performance of Centrifugal Supercharger. By Itirō Watanabe, Hirosi Sibata, Yasuo Nakagawa and Dōsei Toyozawa. Pp. 145–168+25 plates. (Tōkyō: Kōgyō Tosho Kabushiki Kaisha.) 1.65 yen. [252

Norges Svalbard- og Ishavs-Undersøkelser. Meddelelse Nr. 40: Über einige Hieracium-Arten aus Grönland. Von S. O. F. Omang. Pp. 12+3 plates. Meddelelse Nr. 41: Norges Svalbard- og Ishavs-Undersøkelsers Ekspedisjoner til Øst-Grønland sommeren 1937. Av John Giæver. Pp. 8. (Oslo: Jacob Dybwad.) [252

Norges Svalbard- og Ishavs-Undersøkelser. Skrifter om Svalbard og Ishavet. Nr. 71: Zoological Results of the Norwegian Scientific Expeditions to East Greenland, 6. I. Makrolepidopteren aus Nordostgrönland, von Nils Knaben; II. Mikrolepidopteren aus Nordostgrönland, von Emil Barca. Pp. 37+3 plates. 3.50 kr. Nr. 72: Die Downtonischen und Devonischen Vertebraten von Spitzbergen. 6: Lunaspis-arten aus dem Devon Spitzbergens. Von A. Heintz. Pp. 23+1 plate. 2.00 kr. Nr. 73: Report on the Activities of Norges Svalbard- og Ishavs-Undersøkelser 1927–1936. Pp. 125. 10.00 kr. Nr. 74: Some Investigations into the Physiology and Nosology of Eskimos from Angmassalik in Greenland; a Preliminary Statement. By Arne Høygaard. Pp. 14. 1.50 kr. Nr. 75: On the Vascular Plants of Eastern Svalbard, chiefly based on Material brought home from the *Heimland* Expedition 1936. By Eilif Dahl. Pp. 50. 3.50 kr. (Oslo: Jacob Dybwad.) [252

Norges Svalbard- og Ishavs-Undersøkelser. Geleitworte zu den Blättern Claveringöya, Jordan Hill und Geographical Society-Öya der Karte von Nordostgrönland. Von Prof. Dr. Otto Lacmann. Pp. 57+3 maps. (Oslo: Jacob Dybwad.) [252

Sveriges Geologiska Undersökning. Ser. Aa, No. 179: Beskrivning til kartbladet Forshaga. Av R. Sandegren och N. H. Magnusson. Pp. 117. 4.00 kr. Ser. Aa, No. 181: Beskrivning til kartbladet Smedjebacken. Av G. Lundquist och S. Hjelmquist. Pp. 129. 4.00 kr. (Stockholm: P. A. Norstedt and Söner.) [282

Carlsberg Foundation's Oceanographical Expedition round the World 1928–30 and previous "Dana"-Expeditions. Dana-Report No. 12: Hydrographical Observations made during the "Dana"-Expedition 1928–30. Pp. 46. 6.50 kr.; 6s. Dana-Report No. 13: Revision der *Centriscidæ* (*Acanthopterygii centrisciformes*). Von Erna Mohr. Pp. 70+2 plates. 9.00 kr.; 8s. (Copenhagen: C. A. Reitzels Forlag; London: Oxford University Press.) [282

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 194: Design of an Impact Tester to measure Resistance and Extension. By Dr. W. Lawrence Balls. Pp. 19+12 plates. (Cairo: Government Press.) P.T. 3. [282

Summary Proceedings of the Thirty-fifth Meeting of the Indian Central Cotton Committee, Bombay, held on the 9th and 10th August 1937. Pp. 82. (Bombay: Indian Central Cotton Committee.) 1 rupee. [282

Fifty-fourth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1936–1937. Pp. 16. (Washington, D.C.: Government Printing Office.) [282

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 9: College Salaries, 1936. By Walter J. Greenleaf. Pp. v+33. (Washington, D.C.: Government Printing Office.) 10 cents. [282

Symposium on Hormones: Sigma Xi Lectures for 1936–37, Ohio State University. (Reprinted from the "Ohio Journal of Science", Vol. 37, No. 6, November 1937.) Pp. 315–463. (Columbus, Ohio: Society of the Sigma Xi.) 1 dollar. [282

India Meteorological Department. Scientific Notes, Vol. 7, No. 76: Average Intensity of Rainfall on a Rainy Day in India. By V. Doraiswamy Iyer and Kasturinath Sobti. Pp. 103–108+7 plates. (Delhi: Manager of Publications.) 12 annas; 1s. 3d. [282

Ministerio da Educacão e Saude Publica. Observatorio Nacional do Rio de Janeiro. Taboas das Marés para o anno de 1938 nos Portos do Rio de Janeiro, Belém, S. Luiz, Amarracão, Camocim, Fortaleza, Natal, Cabedello, Tambahú, Recife, Aracajú, Bahia, Ilhéos, Victoria, Santos, Paranaguá e Itajahy. Pp. 208. Annuario publicado pelo Observatorio Nacional do Rio de Janeiro para o anno de 1938. (Anno 54.) Pp. xiii+488. (Rio de Janeiro: Observatorio Nacional.) [13

Field Museum of Natural History. Publication 405 (Botanical Series, Vol. 17, No. 4): A Contribution to the Flora of Honduras. By Prof. T. G. Yuncker. Pp. 285–408+18 plates. (Chicago: Field Museum of Natural History.) 1 dollar. [13

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